DEPARTMENT OF THE ARMY PERMIT

Permittee: Forgan Mcintosh
Limetree Bay Terminals, LLC
1 Estate Hope
Christiansted, St. Croix, USVI 00820

Permit No: SAJ-2017-00416 (SP-JCM)

Issuing Office: U.S. Army Engineer District, Jacksonville

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the U.S. Army Corps of Engineers (Corps) having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description:

The project consists in the installation of a Single Point Mooring (SPM) and an underwater pipeline system for the offshore transfer of liquid petroleum products from Very Large Bulk Carriers (VLBCs) to the existing facilities at the Limetree Bay Terminal. This project will provide Limetree Bay Terminals, LLC the ability to receive shipments from VLBCs with drafts up to -76 ft below mean sea level (MSL) without docking at the land-based operations or having to transfer fuel to smaller vessels. The VLBCs would moor to the SPM in deep water (>600 ft), connect to suspended hose lines that will be attached to the pipelines, and off load their products through the transfer system.

The project includes the placement of two 30 inches in diameter concrete coated steel pipelines (steel pipes encased with three inches of concrete), laid parallel from the end of the eastern jetty of the Limetree Bay Terminal to a Pipeline End Manifold (PLEM) to be located offshore at a water depth of 136 feet below mean sea level. Two sections of the parallel pipelines will be placed on the surface of the marine floor, while two other sections will require excavating trenches to allow for the bend radius of the pipelines as they transition off the jetty and as they transition across the existing navigation channel. The installation of the pipeline, including the surface-laid and trenched sections, will be completed in approximately 10 days. At the end of the pipelines, the PLEM will be used to transition the pipelines to two 24 inches in diameter hoses, which will extend seaward suspended mid-water at depths between 135 feet to 250 feet until reaching the SPM.

In order to delineate the mooring area around the SPM, a navigation buoy will be placed at a depth of 100' adjacent to the pipeline in an area of uncolonized sand. This marker buoy will indicate where the pipeline is located so that ships can avoid this area during maneuvers in the channel. Two additional channel marker buoys will be installed on either side of the channel crossing to alert vessels and their pilots where the pipeline crosses the channel to avoid damage to the pipeline by anchoring. Channel marker buoys will be lit with standard buoy lighting. The anchors for the channel marker buoys will consist of poured concrete blocks measuring 2 feet x 2 feet x 2 feet with a steel ring. The anchor blocks will be poured on shore and taken out with a tug and placed by divers using lift bags. The two channel markers will be placed within the 31-foot wide disturbance footprint for the channel trenching.

Prior to the start of any in-water work, divers will mark the pipeline route along the marine floor, and will transplant corals and sessile benthic invertebrates from the project corridor in accordance with the attached Compensatory Mitigation Plan.

Before deploying and installing the pipelines, the pipe segments will be welded together on shore. Then pipe sections will be slowly pulled into position and lowered to the marine bottom in a controlled manner by removal of floats and flooding of the pipe. Divers and/or robots will also assist in the process. Installation of the SPM and pipeline system will continue 24 hour a day without anchoring or spudding of the barge to minimize the potential for pipeline swing, bend and/or damage. This will also avoid potential impacts to benthic habitats from barge anchoring or spudding, as well as from temporary laying down the pipeline on the marine floor. Support bags (offshore bulk bags) will be installed underneath pipeline sections in various locations along the route to rectify unsupported pipeline spans. The support bags could vary in weight, depending on the need and location. Typically, the bag will range from 500 pounds up to 2,500 pounds. The bags will be filled on the barge with commercially available sand. They will be lifted from the barge and lowered to the marine bottom with a crane. Once near their desired location, divers will assist with exact placement. It is anticipated that there will be approximately ten locations requiring support bags along the current route based on the bathymetric data analyzed. However, an actual visual inspection of the line (once installed) will confirm the exact number, size and location of support bags needed.

To install the first offshore section of the pipelines, an approximately 15 feet wide trench will be excavated at the seaward end of the eastern jetty. This will require the temporary removal of a section of the revetment of the jetty. The revetment is composed of concrete dolos (concrete tetrapods used to prevent erosion). After the dolos are removed, the existing pavement or hardbottom marine floor will be broken and approximately 1,200 cubic yards of material, including broken hardbottom and sediments, will be dredged from the footprint of the trench using a land based excavator. The excavated materials will be temporarily stored on the jetty in reinforced silt fences designed so that all runoff from the stockpile is directed back into the trench. To minimize the impact of the oncoming seas and prevent erosion during excavation, an open-ended caisson or cofferdam enclosing the excavation area will be installed.

In order to allow for the pipe bend radius, the trench will extend approximately 35 feet from the end of the existing revetment footprint. Approximately 445 cubic yards of this material will be excavated seaward of the jetty from the revetment footprint and offshore pavement. The trench will be between 7.5 feet and 9.0 feet deep and 31 feet wide in this area. Once the excavation is complete, the pipelines will be placed, the upland trench in the jetty will be refilled with the same material excavated from it, and the dolos returned to their original location to protect the terminus of the jetty. The trench seaward of the revetment will not be filled. However, articulating concrete mattresses 8 feet wide and 15 feet long will be installed on the pipelines within the trench to help stabilize the pipes. The trenching of the hardbottom seaward of the revetment footprint will be completed with a barge mounted excavator with an open bucket so that water will drain as the material is removed. The dolos will be temporarily relocated to an uncolonized area of marine floor to the southeast of the project footprint while the pipelines are installed. The dredge barges will only anchor or put down spuds within the impact corridor in preselected locations to dredge or excavate the trenches.

The second section of the pipelines will be surface lain on the marine floor to the south for 988 feet before turning to the southwest to cross the Limetree Bay Terminal Navigation Channel. It is expected that 115 concrete articulating mattresses (8 feet wide and 25 feet long) will be placed on the pipelines to secure them in place to protect sensitive habitat surrounding them from abrasion and for additional protection from groundings and anchoring.

The third section of the pipeline corridor will require excavating an approximately 470 feet long, 31 feet wide, and an average of 16 feet deep trench to accommodate the pipe bending radius into the channel. The trenches outside of the channel crossing are transition trenches and will be as shallow as possible and still achieve the intended purpose of accommodating the pipeline to bend into the channel. If necessary, up to three temporary steel piles with 18 inches in diameter will be installed to assist in the exact positioning of the pipelines as they curve into the channel. These piles will be placed with a vibratory hammer and will be driven into the area that will be disturbed by the trenching. The trench will then continue 787 feet across the navigation channel and 660 feet up the western channel slope. The excavation will be completed using an extended arm backhoe or a clamshell or bucket type crane excavator mounted on a barge. The channel floor is comprised of soft unconsolidated material which is uncolonized in the area of the crossing. Only the excavated material from the channel bottom will be side cast during the pipe placement. The excavated material from the channel slopes trenches will be brought to the surface, loaded onto a barge, transported to the Limetree facility, and disposed/reused in the uplands based on sediment characterization analysis. Approximately 40,000 cubic yards of sediments will be excavated. Concrete articulating mattresses will be placed over the pipes and at critical areas to further protect the pipes within the trench. The excavation within the channel will ensure that the top of the pipelines will be at least 10 feet below the existing channel floor, which is 60 feet below mean sea level.

The fourth section of the pipelines will begin once the pipelines emerge from the channel. This section of the pipelines will be surface lain in a southwest direction for approximately 2,570 feet to a water depth of 136 feet, terminating at the PLEM. No concrete mattresses will be installed over the pipelines in this section as it crosses over open sand.

The PLEM will be held in place by gravity blocks. The PLEM will have a frame designed to hold 1,000 tons of concrete blocks. The steel PLEM structure will be set in place on the seafloor and the pre-cast concrete blocks will be lowered into place on the framework designed to receive them.

From the PLEM the system will then transition into two 1,500 feet long and 24 inches in diameter hoses, which will be suspended mid-water at depths of 135 feet to 250 feet. The hoses will extend to the floating SPM. Floats and weights will be used to help maintain the hoses in position. The SPM will be positioned at a water depth of 665 feet, which will allow for adequate depth for the tankers to swing without getting into water less than 88 feet. A restricted navigation areas will be established around the SPM. The PLEM hoses and SPM will be illuminated via navigation lights on the marker buoys, to allow for clear visibility of these structures with minimal disturbance to marine life.

Seven anchor piles will be used to stabilize the SPM, and two steel anchor piles would be used to stabilize the floating subsea hoses. The hoses and SPM anchor piles will be approximately 72 inches in diameter and approximately 80 feet in length. The subsea hoses and the SPM will be connected to their respective anchor pilings via steel chains. The nine anchor piles will be installed by drilling and grouting. The method of drilling and grouting piles into position is an industry wide accepted practice whenever soil conditions prohibit the conventional installation methods of driving piles with a hydraulic or other type of pile driving hammer. The process begins with the setting of a temporary support frame on the sea floor. The temporary support frame is only used as a guide and for support of the casing. The drilling string and drilling tool will be lowered from the surface into the casing and will begin to drill through the seafloor materials. The process involves no chemicals, nor does it introduce any other foreign materials to the water. This drilling will be done with very specialized drilling equipment due to the depth of water involved. As the drilling progresses into the seafloor, the casing is lowered into the drilled hole. Upon reaching the designed depth, the drilling tool will be removed, and the actual pile will be placed inside the casing. The casing will be connected to a crane located on the surface support vessel and will be slowly retrieved from the drilled hole. As this casing removal is occurring, grout will be pumped into the annulus between the pile and the drilled hole. Each pile will require approximately 27.7 cubic yards of grout. The grout used will be calculated for each pile based on drilling and grout placement will be monitored by remotely operated vehicle (ROV) to ensure overfilling of the annulus does not occur. Once this grout has set, the pile is now secured permanently into place and ready for use. It is anticipated that it will take two to three days to drill and grout each of the nine piles.

The entire project impact corridor would occupy an area of approximately 3.3718 acres of marine bottom, of which approximately 0.9256 acres would consist of pavement or hardbottom areas which support the essential features of Acropora spp. designated critical habitat.

The work described above is to be completed in accordance with the 12 pages of drawings (Attachment 1), as well as the additional attachments affixed at the end of this permit instrument.

Project Location: The Limetree Bay Terminal Facility is located on the south shore of St. Croix on the former Hovensa Oil Terminal Facility. The project site is located at 1 Estate Hope, Christiansted, St. Croix, USVI.

Directions to site: From the St. Croix Airport, turn east onto the Melvin Evans Highway. The Limetree Bay Terminal Facility is located on the right side of the Highway, after the Diageo Rum Distillery Facility.

Approximate Central Coordinates: Latitude: 17.697756° North
Longitude: -64.740337° West

Permit Conditions

General Conditions:

1. The time limit for completing the work authorized ends on **February 22, 2024**. If you find that you need more time to complete the authorized activity, submit your

request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature and the mailing address of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions (Attachment 2).

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

1. **Reporting Address:** The Permittee shall submit all reports, notifications, documentation and correspondence required by the general and special conditions of this permit to the addresses listed below. The Permittee shall reference permit number SAJ-2017-00416 (SP-JCM), on all submittals.

For the Corps:

a. For standard mail: U.S. Army Corps of Engineers, Regulatory Division, Enforcement Section, P.O. Box 4970, Jacksonville, FL 32232-0019.

b. For email: CESAJ-ComplyDocs@usace.army.mil (not to exceed 10 MB).

For the National Marine Fisheries Service:

a. For standard mail: NOAA Fisheries Service, Southeast Regional Office, 263 13th Avenue South, St. Petersburgh, FL 33791.

b. For e-mail: nmfs.ser.esa.consultations@noaa.gov.

2. **Commencement Notification:** Within 10 days from the date of initiating the work authorized by this permit, the Permittee shall provide a written notification of the date of commencement of authorized work to the Corps.

3. **Self-Certification:** Within 60 days of completion of the work authorized by this permit, the Permittee shall complete the attached "Self-Certification Statement of Compliance" form (Attachment 3) and submit it to the Corps. In the event that the completed work deviates in any manner from the authorized work, the Permittee shall describe the deviations between the work authorized by this permit and the work as constructed on the "Self-Certification Statement of Compliance" form. The description of any deviations on the "Self-Certification Statement of Compliance" form does not constitute approval of any deviations by the Corps.

4. **Agency Changes/Approvals:** Should any other agency require and/or approve changes to the work authorized or obligated by this permit, the Permittee is advised a modification to this permit instrument is required prior to initiation of those changes. It is the Permittee's responsibility to request a modification of this permit from the Corps. The Corps reserves the right to fully evaluate, amend, and approve or deny the request for modification of this permit.

5. **Fill Material:** The Permittee shall use only clean fill material for this project. The fill material shall be free from items such as trash, debris, automotive parts, asphalt, construction materials, concrete block with exposed reinforcement bars, and soils contaminated with any toxic substance, in toxic amounts in accordance with Section 307 of the Clean Water Act.

6. **Assurance of Navigation and Maintenance:** The Permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structures or work herein authorized, or if in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters,

the Permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

7. **Posting of Permit:** The Permittee shall have available and maintain for review a copy of this permit and approved plans at the construction site.

8. **Biological Opinion:** This permit does not authorize the Permittee to take an endangered species. In order to legally take a listed species, the Permittee must have separate authorization under the Endangered Species Act (ESA) (e.g., an ESA Section 10 permit, or a BO under ESA Section 7, with "incidental take" provisions with which you must comply). The enclosed NMFS Biological Opinion (BO) (Attachment 4) contains mandatory terms and conditions to implement the Reasonable and Prudent Measures (RPMs) that are associated with the Incidental Take Statement (ITS) that is also specified in the BO. Authorization under this permit is conditional upon compliance with all of the mandatory terms and conditions associated with the ITS of the enclosed BO, which terms and conditions are incorporated by reference in this permit. Failure to comply with the terms and conditions associated with incidental take of the BO, where a take of the listed species occurs, would constitute an unauthorized take, and it would also constitute noncompliance with this permit. The NMFS is the appropriate authority to determine compliance with the terms and conditions of its BO, and with the ESA. The Permittee shall immediately notify the Corps and NMFS if at any time the authorized project exceeds the amount or extent of incidental take anticipated in the BO.

9. **Sea Turtle and Smalltooth Sawfish Conditions:** The authorized work shall be completed in strict observance of the attached NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006 (Attachment 5).

10. **Vessel Strike Avoidance:** The authorized work shall be completed in strict observance of the attached NMFS's *Vessel Strike and Avoidance Measures and Reporting for Mariners*, revised February 7, 2008 (Attachment 6).

11. **Manatee Conservation Measures:** The authorized work shall be completed in strict observance of the attached FWS' Manatee Conservation Measures, dated January 2012 (Attachment 7).

12. **Water Quality and Environmental Monitoring:** The authorized work shall be completed in strict observance of the attached Water Quality and Environmental Monitoring Plan (Attachment 8). The Permittee shall implement all the Water Quality

Control Measures detailed in this plan, including the deployment of the required Turbidity Barriers and Sediment and Erosion Controls. The Permittee shall provide reports with all data related to the implementation of this Water Quality and Environmental Monitoring Plan, including all pre-construction activities, baseline establishment, and monitoring results, to the Corps and NMFS in accordance with the schedule established in the plan. If during the monitoring the water quality protective measures being implemented are found not to provide adequate protection to aquatic resources, the Permitee shall notify NMFS and the Corps. Additional protective measures shall then be developed and implemented by the Permittee in coordination with NMFS and the Corps.

13. **Compensatory Mitigation:** In addition to the measures described in the above conditions, to further minimize and compensate for project related impacts to the aquatic environment the Permittee shall be responsible for the implementation of all measures and actions described in the attached Compensatory Mitigation Plan (Attachment 9).

14. **Compensatory Mitigation Release:** The Permittee's responsibility to complete the required compensatory mitigation, as set forth in this permit will not be considered fulfilled until mitigation success has been demonstrated and written verification has been provided by the Corps. A mitigation area which has been released will require no further monitoring or reporting by the Permittee; however the Permittee, Successors and subsequent Transferees remain perpetually responsible to ensure that the mitigation area(s) remain in a condition appropriate to offset the authorized impacts in accordance with General Condition 2 of this permit.

15. **Financial Assurance:** To ensure that the above described mitigation and monitoring is successful, prior to the initiation of the work authorized by this permit the Permittee will secure a performance bond in the amount of $1,590,500.00, which is the estimated cost of the mitigation program and subsequent monitoring throughout the implementation and monitoring period.

a) Prior to the initiation of the work authorized by this permit, a copy of the draft financial assurance instrument shall be provided to the Corps for review and approval.

b) A copy of the fully executed financial assurance instrument shall be provided to the Corps before initiation of the authorized work.

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

(X) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403)

(X) Section 404 of the Clean Water Act (33 U.S.C. 1344)

( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413)

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, State, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal projects.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (see 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions: General Condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

February 21, 2019

(PERMITTEE) Limetree Bay Terminals, LLC
By: Forgan McIntosh, Vice President

(DATE)

Limetree Bay Terminals, LLC

(PERMITTEE NAME-PRINTED)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

S. Castillo

February 22, 2019

(DISTRICT ENGINEER)
for Andrew D. Kelly, Jr.
Colonel, U.S. Army
District Commander

(DATE)

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

____________________________________ ____________________
(TRANSFEREE-SIGNATURE) (DATE)

____
(NAME-PRINTED)

____
(ADDRESS)

____
(CITY, STATE, AND ZIP CODE)

Attachments to Department of the Army Permit Number SAJ-2017-00416 (SP-JCM)

1. PERMIT DRAWINGS: 12 pages, dated February 2018

2. WATER QUALITY CERTIFICATION: Specific Conditions of the water quality permit/certification in accordance with General Condition number 5 on page 6 of this DA permit. 3 pages.

3. SELF-CERTIFICATION FORM: 1 page, *Self-Certification Statement of Compliance.*

4. NMFS Biological Opinion (BO) issued on February 12, 2019

5. SEA TURTLE – SAWFISH CONDITIONS: 1 page, *Sea Turtle and Smalltooth Sawfish Construction Conditions, revised March 23, 2006.*

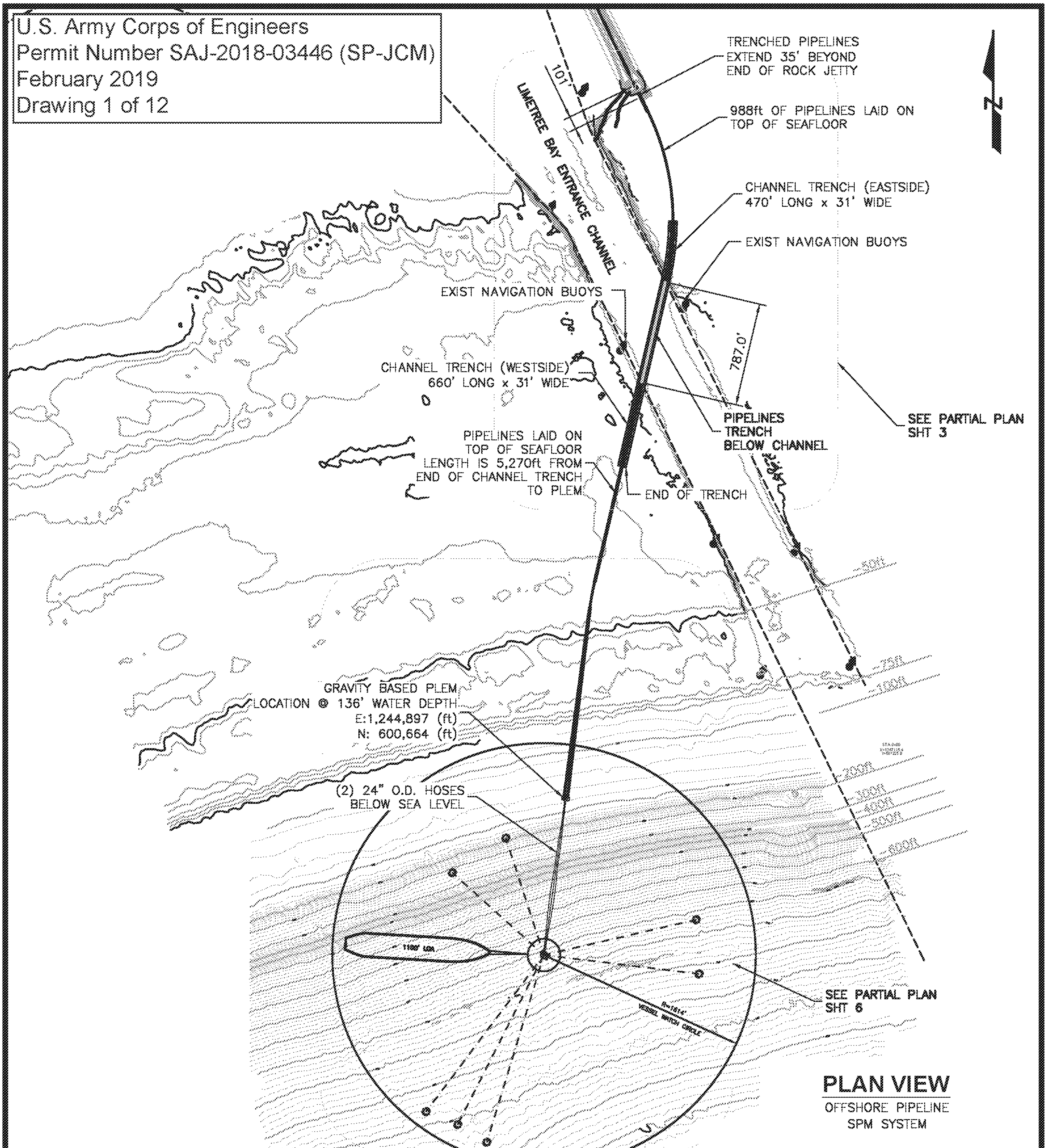
6. VESSEL STRIKE AVOIDANCE MEASURES: 2 Pages, *Vessel Strike Avoidance Measures and Reporting for Mariners, revised February 2008.*

7. USFWS ANTILLEAN MANATEE CONSERVATION MEASURES

8. WATER QUALITY AND ENVIRONMENTAL MONITORING PLAN.

9. MINIMIZATION AND COMPENSATORY MITIGATION PLAN.

U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 1 of 12



PLAN VIEW

OFFSHORE PIPELINE
SPM SYSTEM

NOTE:
ARRANGEMENT SHOWN IS CONCEPTUAL PER INITIAL DESIGN REQUIREMENTS.

SCALE: 1:1000

PURPOSE:	INSTALLATION OF A SINGLE POINT MOORING SYSTEM FOR BULK FUEL SHIPMENTS	OWNER:	LIMETREE BAY TERMINALS, LLC	DESIGN BY:	GAB
		APPLIED BY:	LLOYD ENGINEERING	DRAWN BY:	RC
		APPLIC. No:	XXX	SCALE:	AS NOTED
LOCATION:	U.S. VIRGIN ISLANDS UNITED STATES	COUNTY:	XXX	DATE:	05/02/18
		WATER BODY:	CARIBBEAN SEA	SHEET No:	2
		DATUM:	NAD83		

LLOYD ENGINEERING, INC
HOUSTON TEXAS, USA
LICENSE NO. 32262

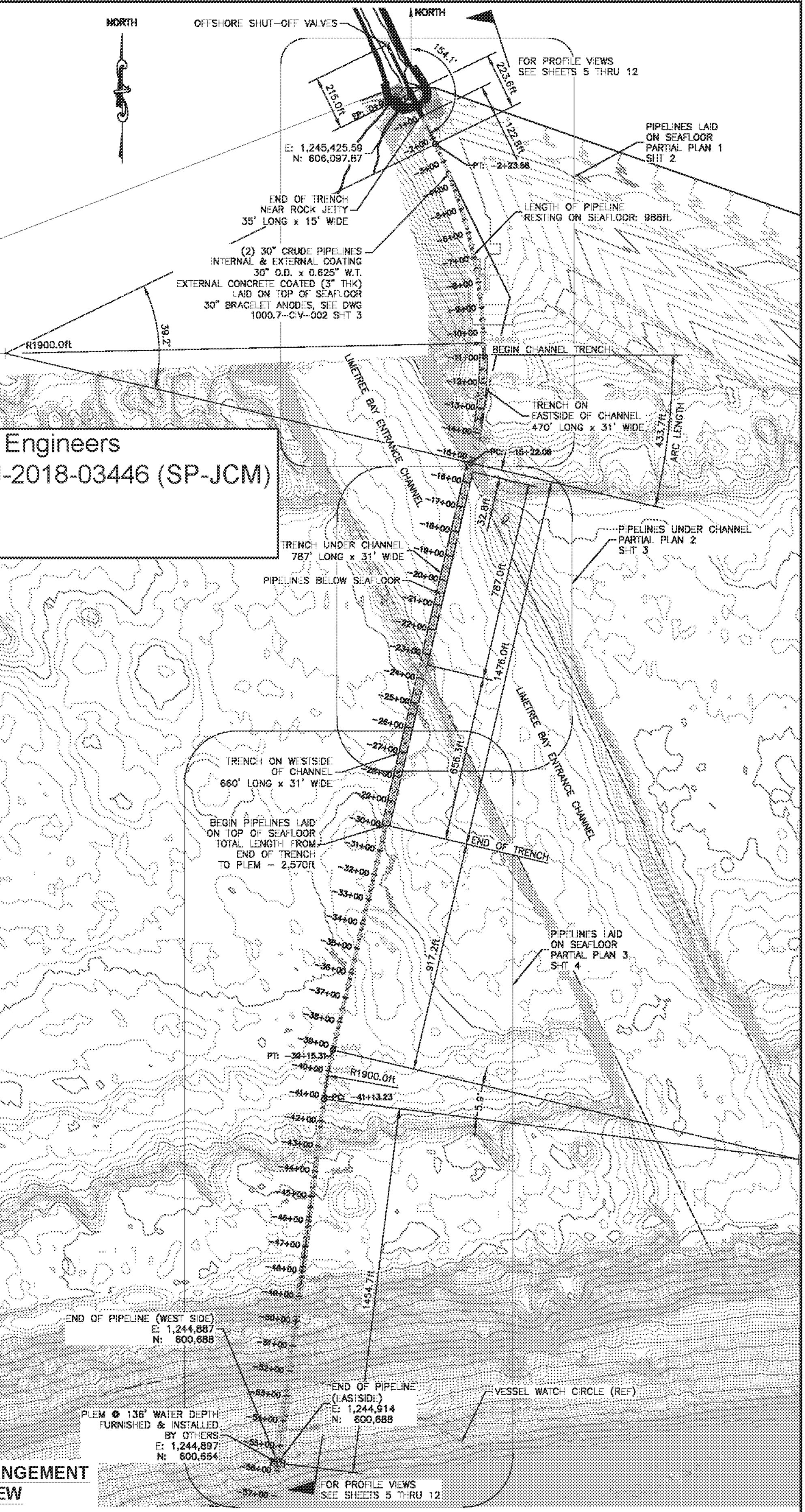
FILE NAME: L:\International LEI Projects\Limetree (St Croix)\St Croix\4_Design and Permitting phase -- CURRENT\DesignCADfiles\Permits\DsizeFormat\PermitAsizeUpdated.dwg LAYOUT NAME: PermitOffshoreRoute PLOTTED: Wednesday, February 13, 2019 - 10:24am USER: rc

FILE NAME: L:\International LE Projects\Limetree (St Croix)\St Croix\4_Design and Permitting phase - CURRENT\DesignCADFiles\Permits\IFC\1000.7CIV001SideVIew4.dwg LAYOUT NAME: OverallPlan PLOTTED: Wednesday, August 29, 2018 - 6:52pm USER: rc

GENERAL NOTES

1. ON AND OFF-SITE PREPARATION:
   THE CONTRACTOR SHALL CONFIRM THAT HE HAS READ AND IS FAMILIAR WITH ALL SPECIFICATIONS COVERING THE PREPARATION OF THE PIPE FOR FIELD WELDING, METHODS OF REPAIRING ACCIDENTAL DAMAGE TO THE PIPE, COATINGS, CONCRETE WEIGHT COVER AND FOR INSTALLATION OF THE PIPE ON THE SEA FLOOR.
2. PREPARATION OF THE PIPELINE ROUTE:
   THE CONTRACTOR SHALL RUN A DETAIL SURVEY OF THE BOTTOM ALONG THE ROUTE PRIOR TO LAYING ANY PIPE AND DETERMINE WHERE SUPPORTING SAND/CEMENT BAGS ARE REQUIRED. THESE BAGS ARE TO BE PLACED PRIOR TO THE PIPE LAYING OPERATION. CONCRETE BLOCK MATTRESSES SHALL BE LAID ON TOP OF THE PIPE OVER EACH SUPPORTED POINT AS SHOWN ON SHEET 6 IN THE TYPICAL D SECTION VIEW.
3. ALL WATER DEPTH ELEVATIONS ARE IN FEET, AND REFER TO MLLW (MEAN LOWER LOW WATER).
4. PIPE LAY METHODS:
   PIPE MAY BE LAID FROM A LAY BARGE EQUIPPED TO HANDLE CONCRETE COATED PIPE OR BY FABRICATING PIPE STRINGS ASHORE, TOWING INTO PLACE AND THEN LOWERING THE PIPE TO THE BOTTOM BY CONTROLLED FLOODING AND RELEASE OF FLOATATION DEVICES. CONTRACTOR TO PROVIDE EXECUTION PLAN FOR INSTALLATION PRIOR TO MOBILIZING TO THE SITE.
5. AN ELECTRICAL ISOLATING KIT SHALL BE INSTALLED ON THE SHORE END OF THE PIPELINES.
6. PRESSURE RELIEF VALVES SHALL BE INSTALLED AROUND ALL VALVES RELIEVING LOCKED IN STATIC THERMAL INDUCE PRESSURES BACK TO THE TANK. THESE VALVES SHALL BE SET FOR 280psi.
7. ALL VALVES WILL HAVE 150 SERIES FLANGES W/ SERIES B BOLT CIRCLES.

U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 2 of 12



GENERAL ARRANGEMENT PLAN VIEW

DESIGN BY:	G.A.B.
DRAWN BY:	RC
DATE:	9-13-17
SCALE:	1:200 @ 22"X34"
SHEET:	1 OF 13
DRAWING NO. REV.	1000.7-CIV-001

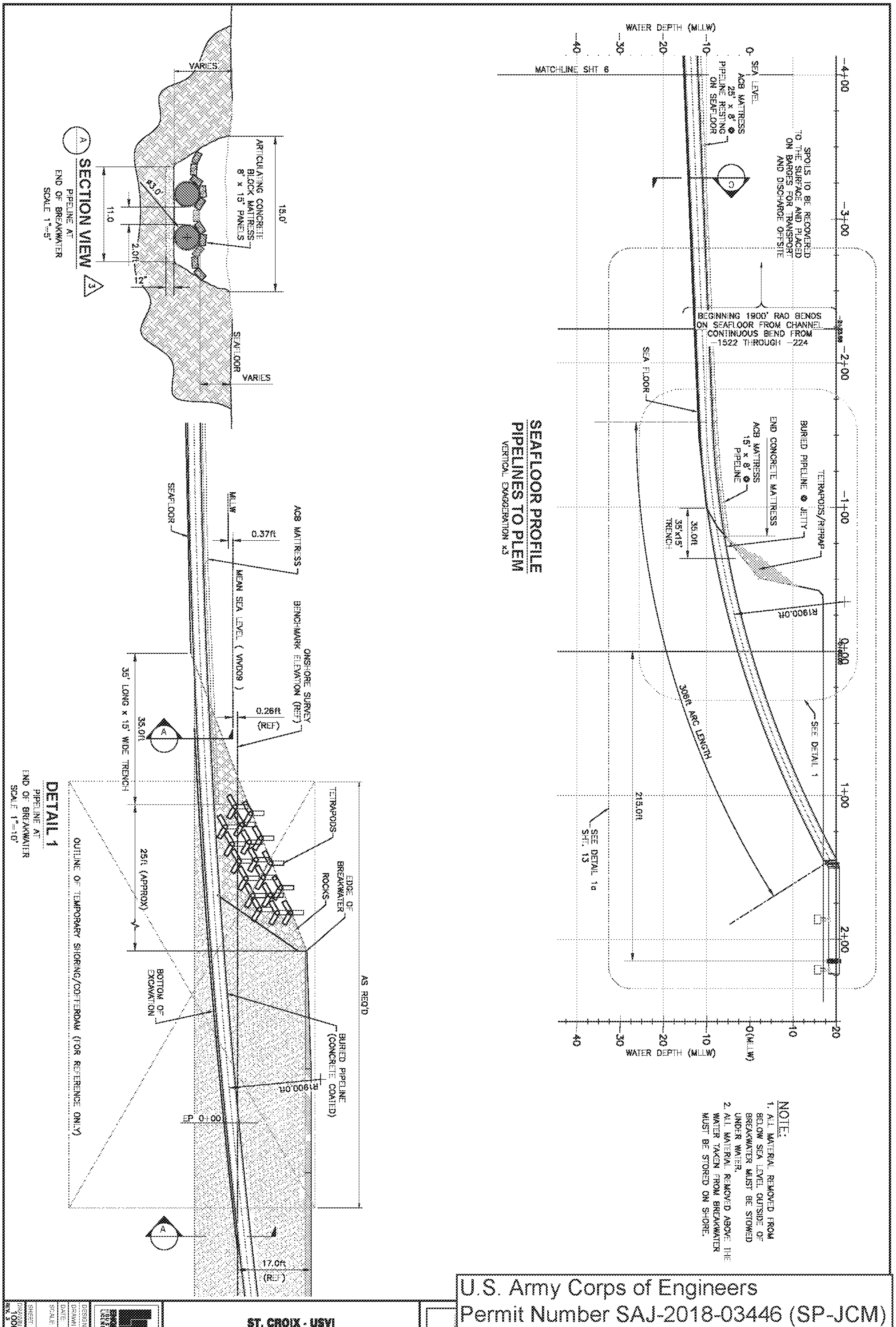
LLOYD ENGINEERING, INC. HOUSTON, TEXAS, USA LICENSE NO. F-002644

ST. CROIX - USVI

OFFSHORE PIPELINES ALONG SEAFLOOR
ISSUED FOR CONSTRUCTION

ISSUED FOR CONSTRUCTION

NO.	DESCRIPTION	DATE	APPR
3	GENERAL CLARIFICATIONS	[illegible]	RP
2	UPDATED FILL MATERIALS AND SPOIL TRANSPORT	[illegible]	RP
1	[illegible]	[illegible]	RP
0	ISSUED FOR CONSTRUCTION	[illegible]	RP



U.S. Army Corps of Engineers
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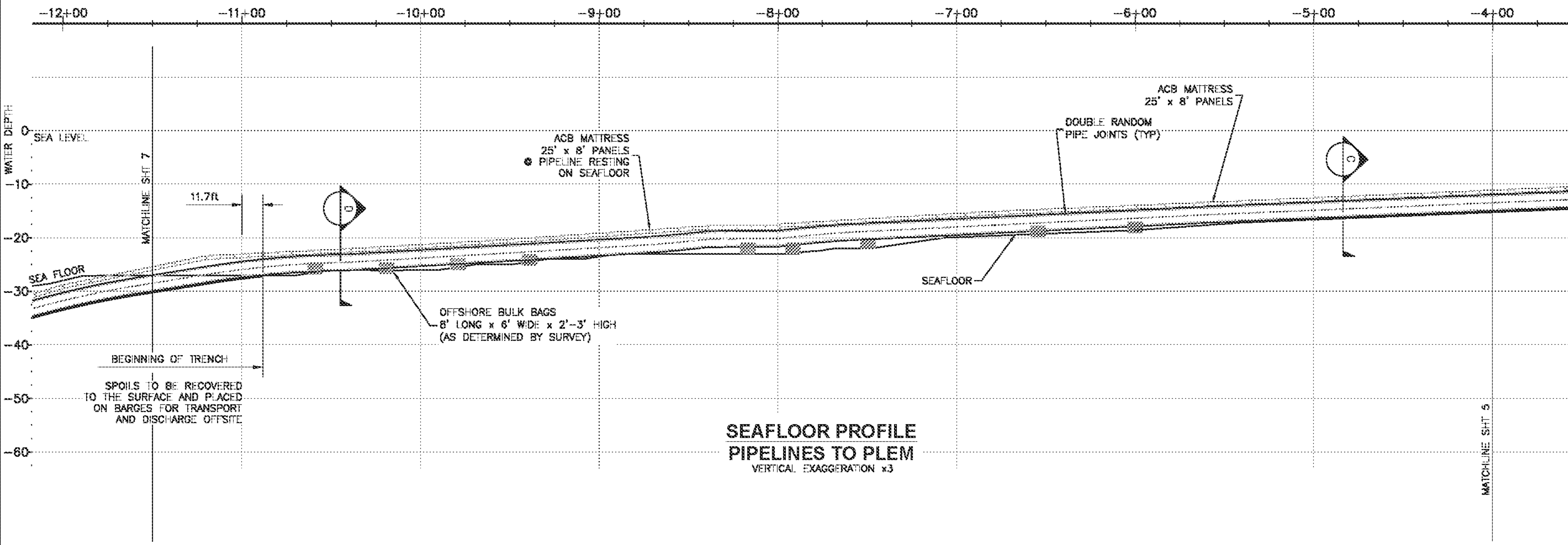
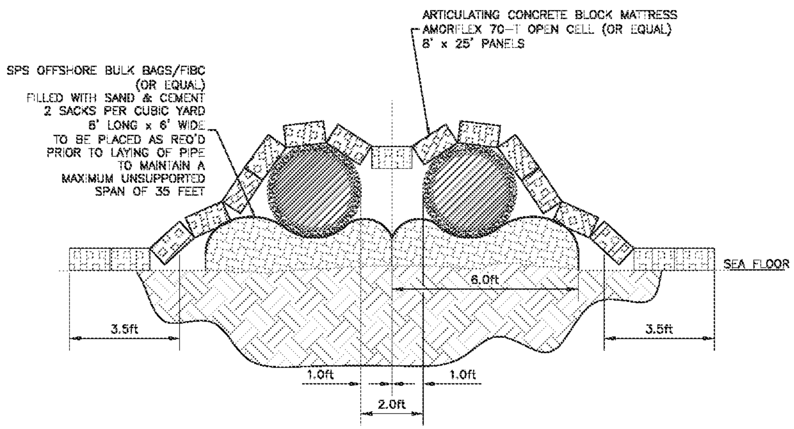
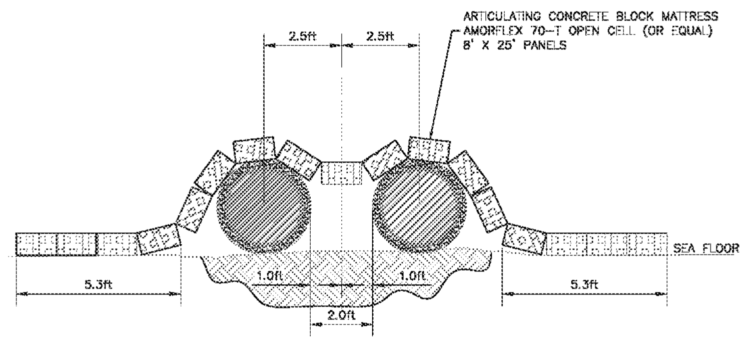
Drawing 3 of 12



SEAFLOOR PROFILE
PIPELINES TO PLEM
VERTICAL EXAGGERATION x3



D **SECTION VIEW**
TYP PIPELINE SUPPORT



C **SECTION VIEW**
PIPELINE ON SEAFLOOR
NEAR BREAKWATER

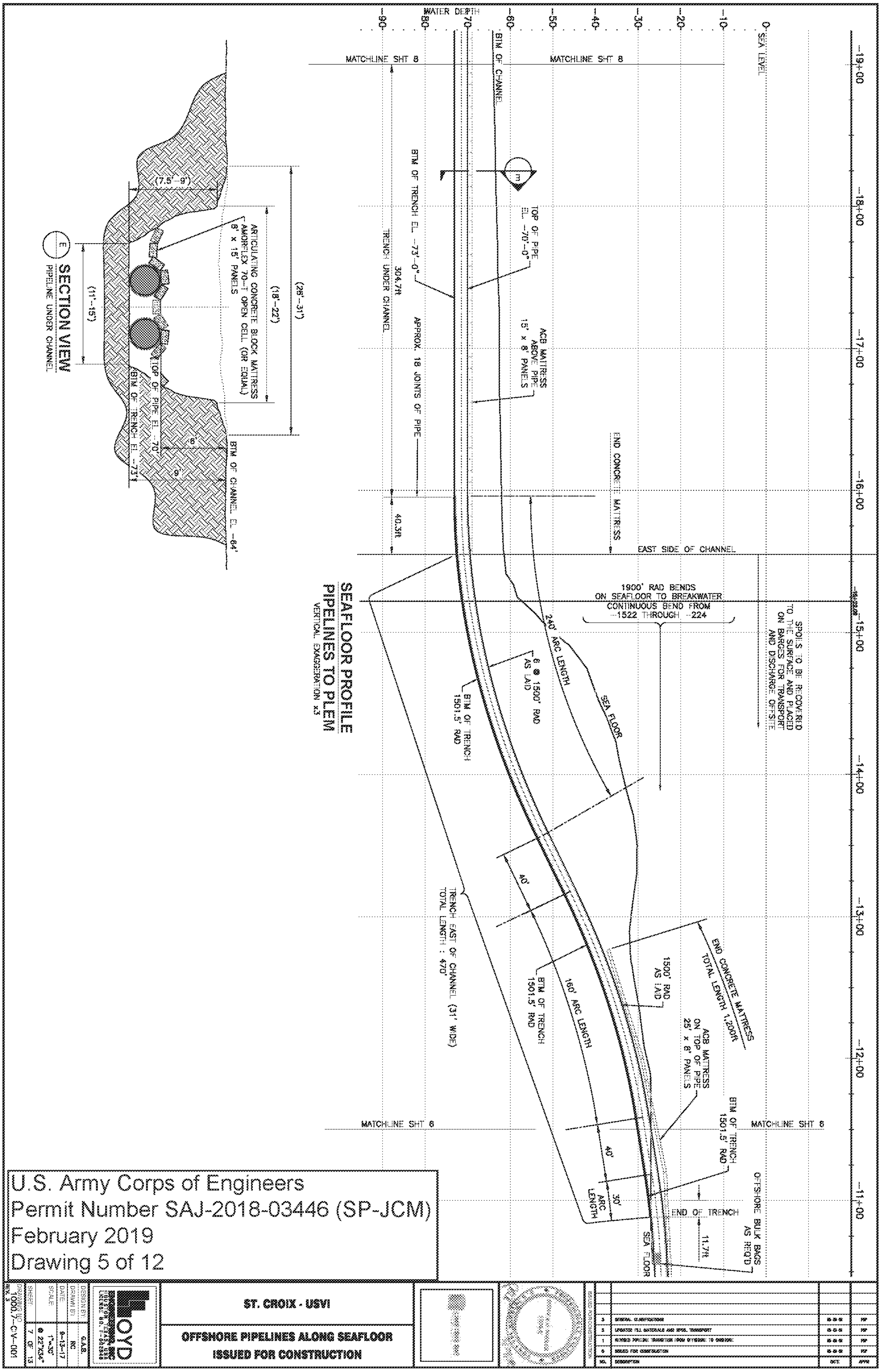
U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 4 of 12

ST. CROIX - USVI

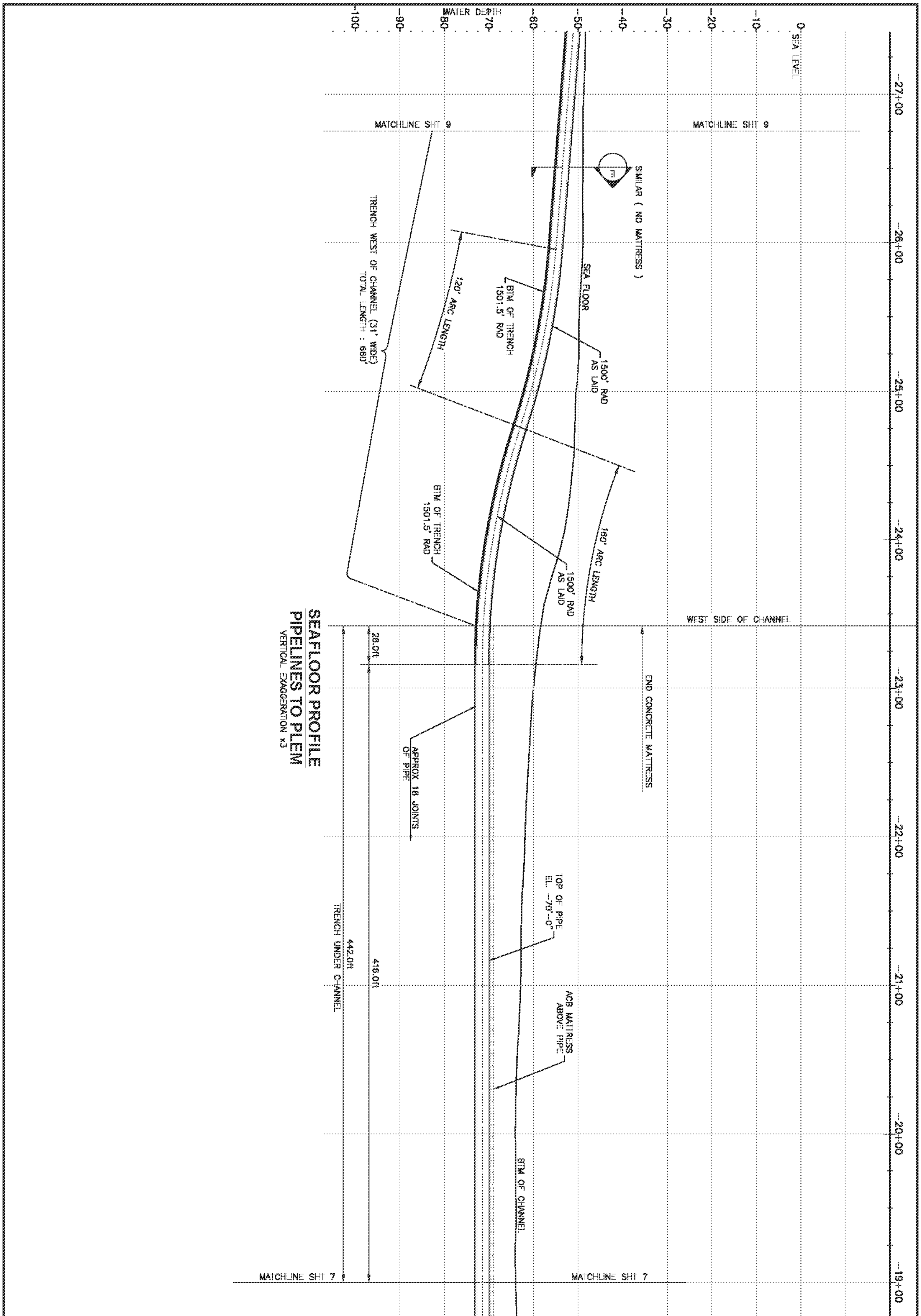
OFFSHORE PIPELINES ALONG SEAFLOOR
ISSUED FOR CONSTRUCTION

LLOYD ENGINEERING, INC
HOUSTON, TEXAS, USA
LICENSE NO. F-002846

DESIGN BY:	G.A.B.
DRAWN BY:	RC
DATE:	9-13-17
SCALE:	1"=30' @ 22"X34"
SHEET:	8 OF 13
DRAWING NO.	1000.7-CIV-001 REV. 3



U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 5 of 12



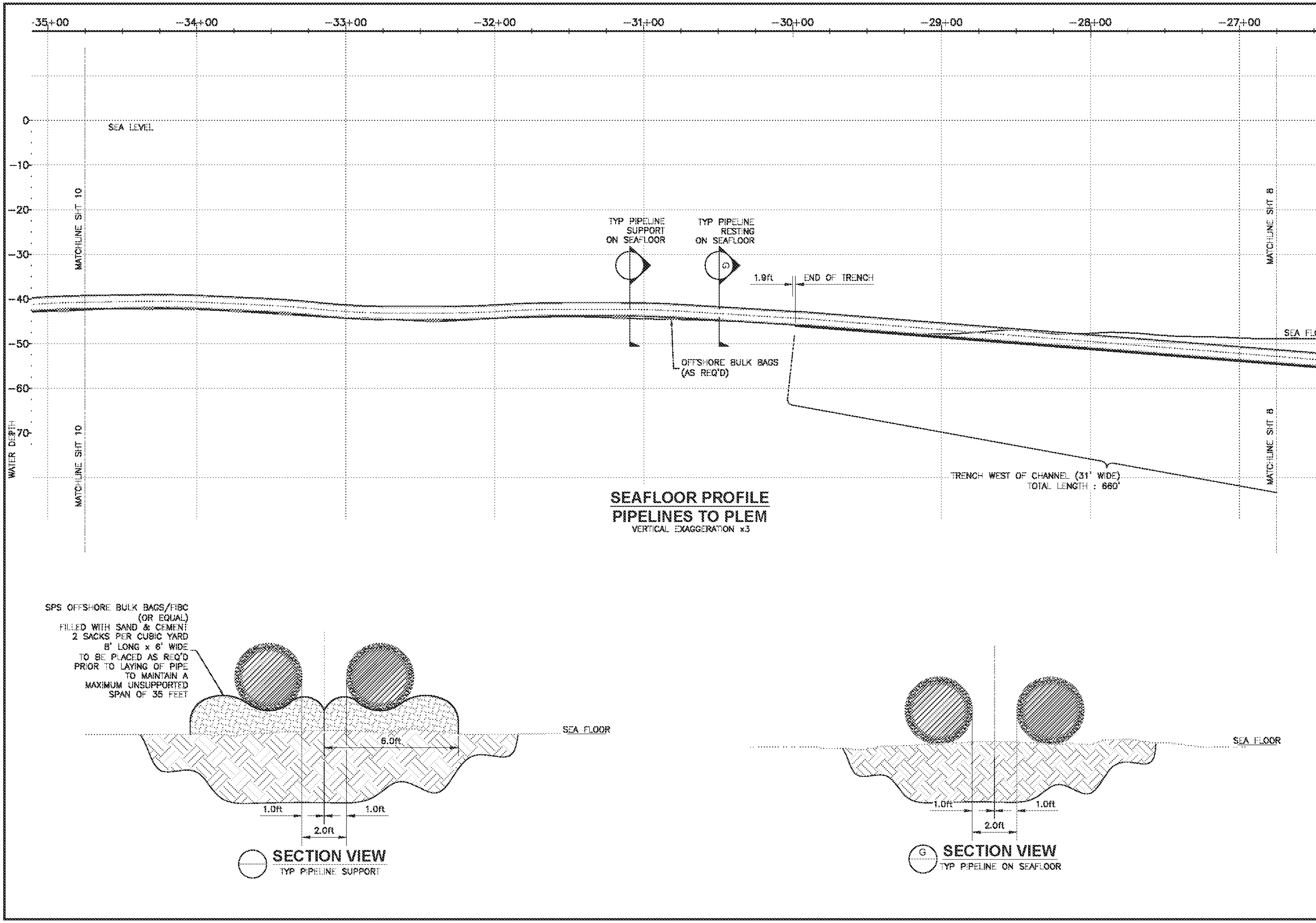
LLOYD

DESIGN BY:	G.A.B.
DRAWN BY:	RC
DATE:	9-13-17
SCALE:	1"=30' @ 22"X34"
SHEET:	8 OF 13
DRAWING NO:	10007-C-V-001 REV. 3

ST. CROIX - USVI

OFFSHORE PIPELINES ALONG SEAFLOOR
ISSUED FOR CONSTRUCTION

U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 6 of 12



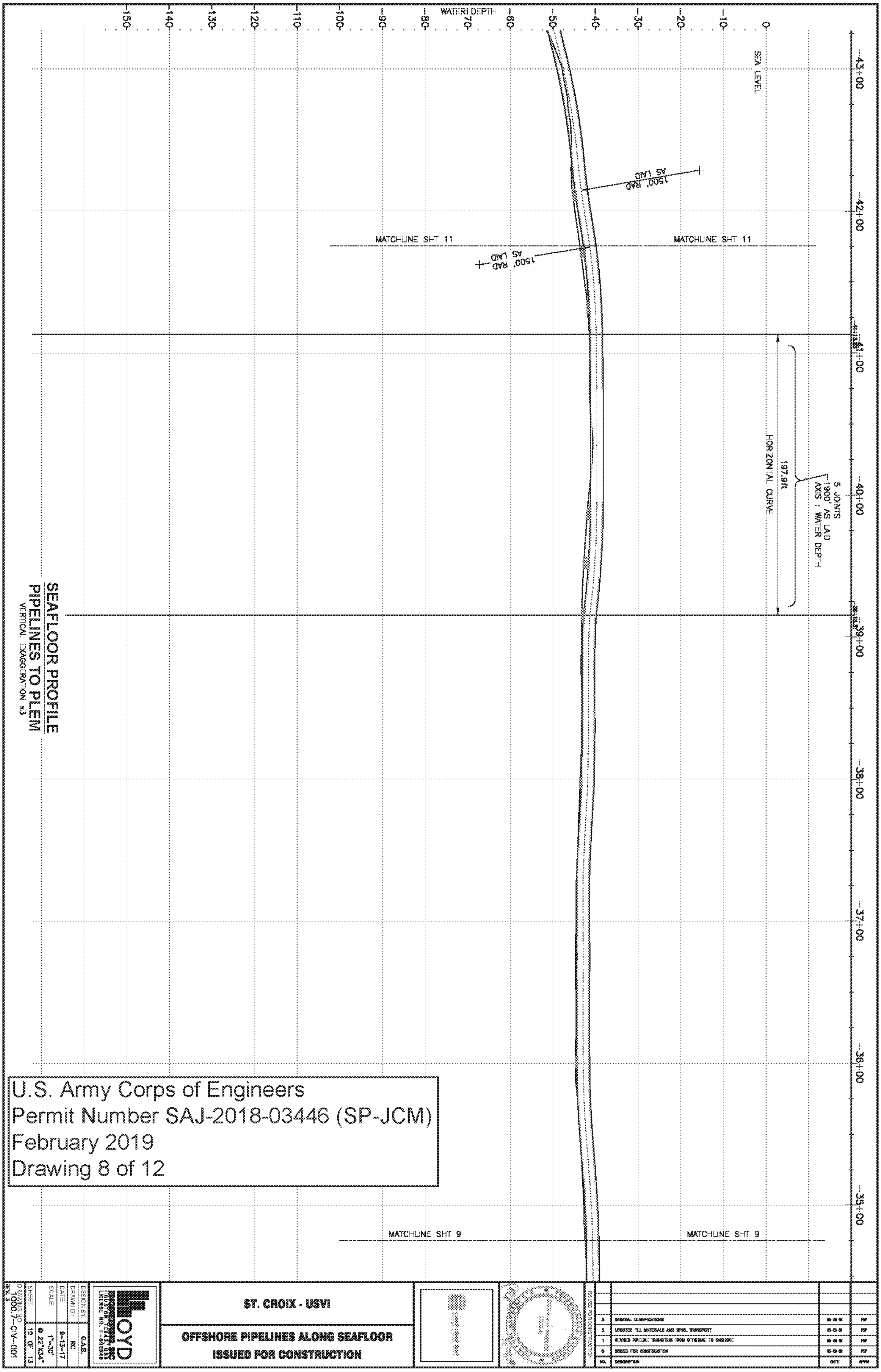
U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 7 of 12

ST. CROIX - USVI

OFFSHORE PIPELINES ALONG SEAFLOOR
ISSUED FOR CONSTRUCTION

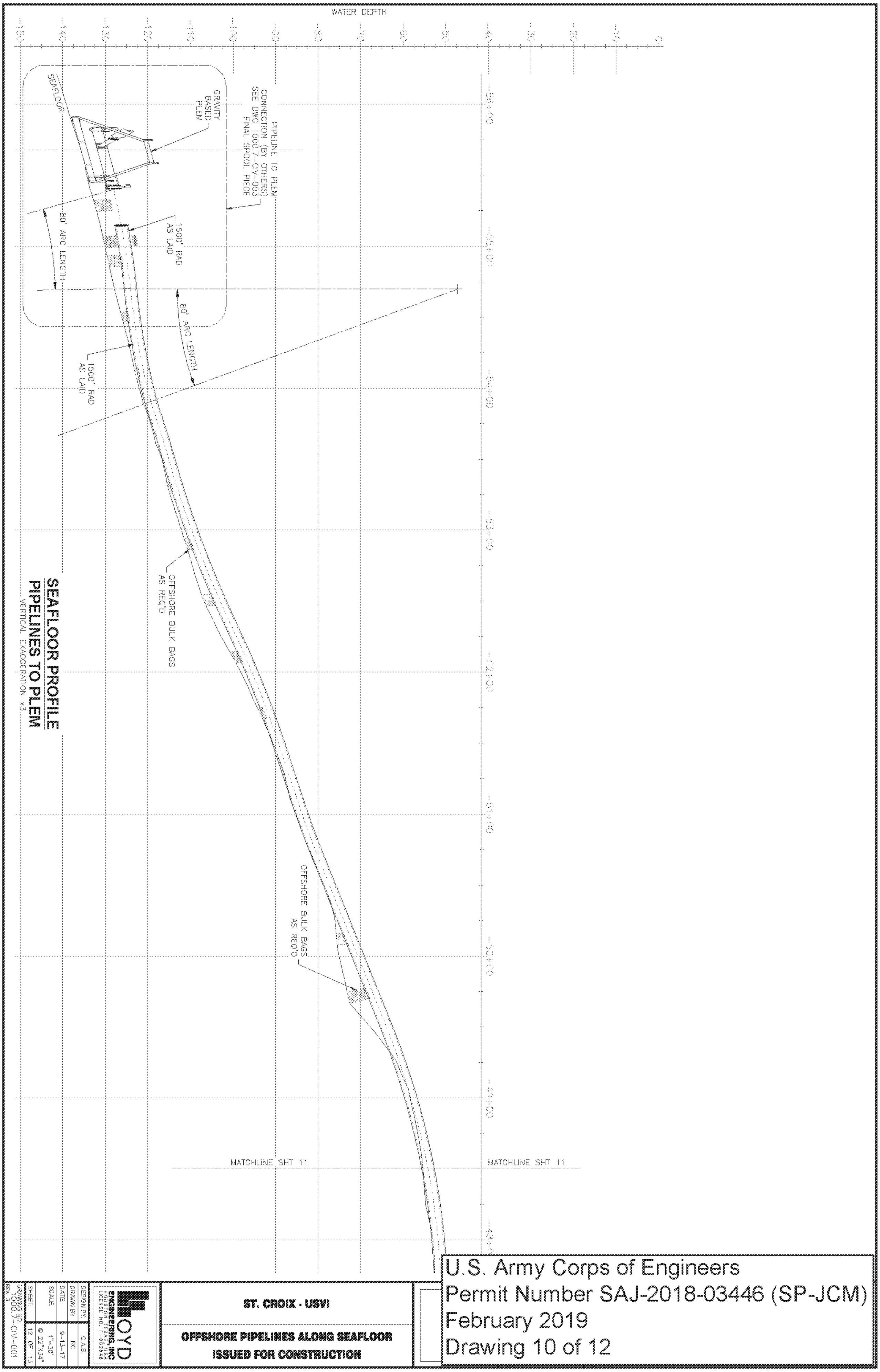
LLOYD ENGINEERING, INC
HOUSTON TEXAS, USA
LICENSE NO. F-002846

DESIGN BY:	G.A.B.
DRAWN BY:	RC
DATE:	9-13-17
SCALE:	1"=30' @ 22"X34"
SHEET:	9 OF 13
DRAWING NO.	1000.7-CIV-001
REV. 3	

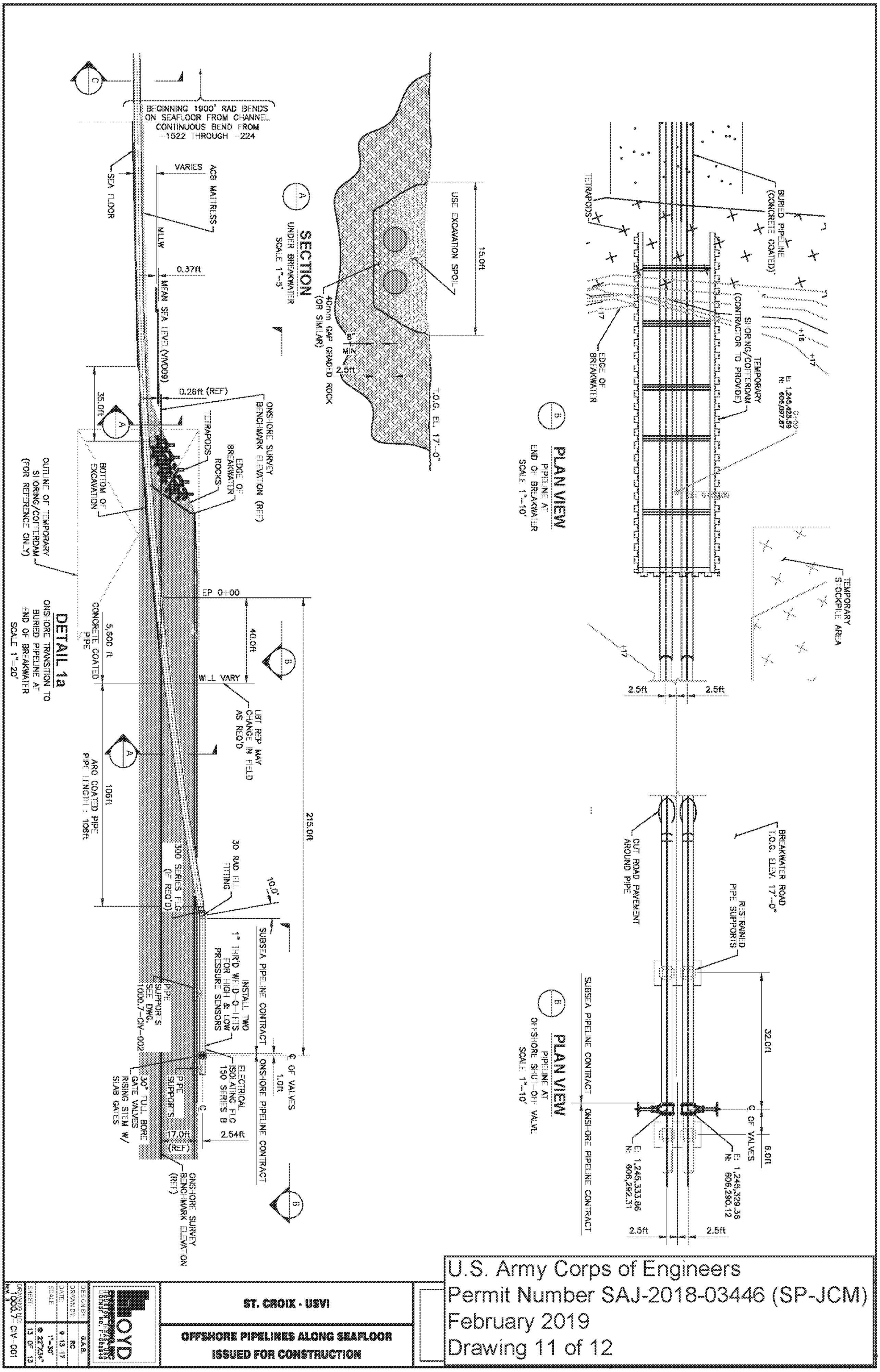


U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 8 of 12

U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 9 of 12

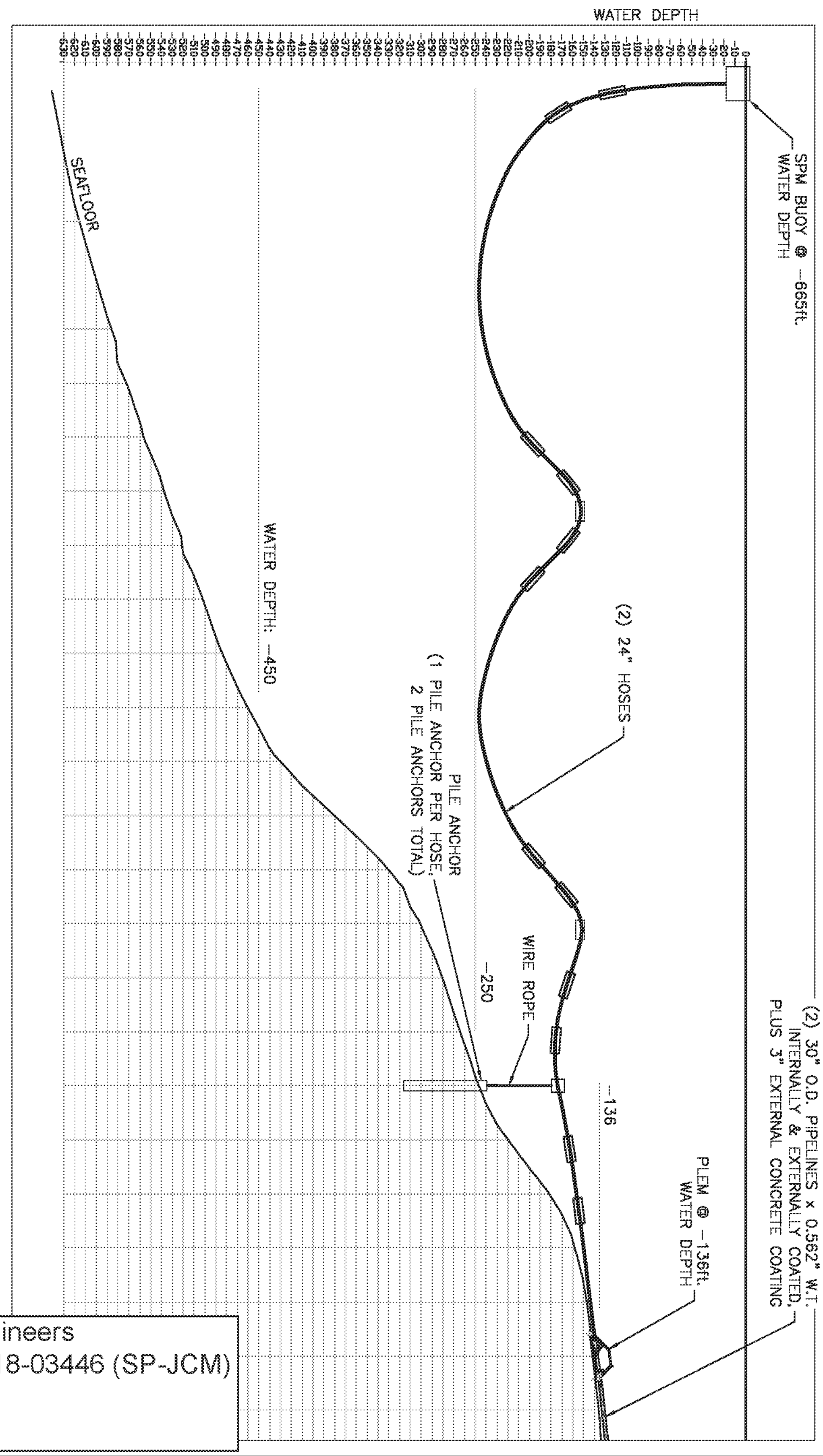


U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 10 of 12



U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 11 of 12

FILE NAME: L:\International LEI Projects\Limetree (St Croix)\St Croix\4_Design and Permitting phase – CURRENT\DesignCADfiles\Permits\DsizeFormat\PermitAsizeUpdated.dwg LAYOUT NAME: PermitPLEMtoBuoy PLOTTED: Wednesday, February 13, 2019 – 10:21am USER: rc



E
6

ELEVATION
PIPELINE HOSES FROM PLEM TO BUOY
SCALE 1:150
LOOKING TO SHORE

U.S. Army Corps of Engineers
Permit Number SAJ-2018-03446 (SP-JCM)
February 2019
Drawing 12 of 12

PURPOSE:	INSTALLATION OF A SINGLE POINT MOORING SYSTEM FOR BULK FUEL SHIPMENTS	OWNER:	LIMETREE BAY TERMINALS, LLC	LLOYD ENGINEERING, INC HOUSTON TEXAS, USA LICENSE NO. 32262	DESIGN BY:	GAB
		APPLIED BY:	LLOYD ENGINEERING		DRAWN BY:	RC
		APPLIC. No:	XXX		SCALE:	AS NOTED
LOCATION:	U.S.VIRGIN ISLANDS UNITED STATES	COUNTY:	XXX		DATE:	05/02/18
		WATER BODY:	CARIBBEAN SEA		SHEET No:	7
		DATUM:	NAD83			

GOVERNMENT OF THE VIRGIN ISLANDS OF THE UNITED STATES

DEPARTMENT OF PLANNING AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
45 MARS HILL
FREDERIKSTED, ST. CROIX, VI 00840
PHONE: (340) 773-1082, FAX: (340) 773-9310

Coastal Zone Permit Application
Water Quality Review and Certification

1. **CZM PERMIT APPLICATION №:** CZX-29-17(L&W)

2. **DPNR, DEP WATER QUALITY CERTIFICATE No:** WQC-19-004(L&W) **(Supersedes WQC-18-001(L&W))**

3. **Date of Final Application**: August 21, 2017 (Original) September 26, 2018 (Modification)
Date of Final Review: February 22, 2018 (Original) November 29, 2018 (Modification)

4. **SHORT TITLE OF WORK:**
Limetree Bay Terminals is proposing to install a Single Point Mooring (SPM) off the existing marine terminal on the south shore of St. Croix. The project will include the placement of two concrete coated 30" OD pipelines which will be buried for the transition off the end of the eastern jetty and then lain on the seafloor to the outer edge of the Limetree Channel. The pipelines will be surface lain on the marine floor to the south over the next 988 feet before turning to the southwest through the Limetree Bay Terminal Navigation Channel. Up to 3 temporary piles may be driven to assist in the exact positioning of the pipelines as they curve into the channel. These piles would be placed with a vibratory hammer and would be driven into the area that will be disturbed by the trenching. The pipelines would then cross the Limetree Bay Terminal Navigation Channel, then be buried down the channel wall, beneath the uncolonized channel bottom and then up the slope on the western side of the channel where they will emerge and be surface lain to the depth of 136 feet where the PLEM will be placed. The system will then transition into two 24-inch OD, 1,500-foot-long hoses which will be suspended mid water column to the Buoy Balance Position for the SPM. Seven (7) anchor piles would be used to stabilize the SPM and two (2) steel anchor piles would be used to stabilize the floating subsea hoses. The hose and SPM anchor piles would be approximately 72 inches in diameter and approximately 80 feet in length. The PLEM, the subsea hoses and the SPM would be connected to their respective anchor pilings via steel chains. The piles will be drilled and grouted piles. These piles will stabilize the SPM in a position which will allow for adequate depth for the tankers to swing without getting in to water less than 88ft. Three anchors may also be placed on the floated hoses if necessary. The hose anchors and the SPM anchors may be traditional drag anchors or may be anchor piles depending on the substrate. The installation of the SPM will give Limetree Bay Terminals, LLC the ability to handle bulk fuel shipments from Very Large Bulk Carriers.

5. **APPLICANT:** Limetree Bay Terminals, LLC
1 Estate Hope
Christiansted, VI 00820

6. **SUB-WATERSHED:** HOVENSA HUC- 21020002020020

7. **WATER QUALITY CERTIFICATION:**
<u>**Granted With Conditions**</u>: There is currently reasonable assurance that the proposed project can be executed without violations of the Water Quality Standards cited in Annotated (Ann.) Title (Tit.) 12 Virgin

Islands Code Chapter 7, Section 186. The permittee shall comply with all Territorial Rules and Regulations, Federal Statutes, Orders, and permits issued by Territorial and/or Federal departments or agencies.

8. COMMENTS OR SPECIAL RESTRICTIONS:

A. Work shall be performed in a manner that will not adversely impact existing water quality. Existing water quality conditions will be determined in the baseline water quality monitoring survey, conducted by the applicant, and submitted to DPNR – Division of Environmental Protection (DEP) for review prior to the commencement of the project. In no case shall work be performed in a manner that causes any exceedence of the Virgin Islands Water Quality Standards found in Title 12, Chapter 7, Section 186 of the Virgin Islands Rules and Regulations. *The applicant should note that the Assessment Unit in which this work is taking place (AU-STC-61) is an Impaired Waterbody and therefore, special attention will be given to ensure that water quality is protected.* It is currently listed for Phosphorous, Temperature, Dissolved Oxygen, Turbidity and Enterococci impairments.

B. DPNR-DEP reserves the right to temporarily suspend any activity which may cause any adverse environmental impact or results in any noncompliance with Title 12 of the Virgin Islands Rules and Regulations.

C. DPNR-DEP reserves the right to require additional sampling/monitoring as promulgated in Title 12 of the Virgin Islands Code, Section 189.

D. All other federal and territorial permits must be obtained and maintained prior to commencement of any development activities. The Permittee is required to obtain approvals from the US Coast Guard, to include any requirements on minimum depth, lighting, etc. prior to the installation of the buoy.

E. No oil or debris may be discharged from any source during the installation (construction of) or operations of said proposed project.

F. **Prior to the start of any in-water activities**, the open-ended caisson, turbidity curtains and other appropriate mitigation measures shall be installed and properly maintained around the project area and the excavation barge to restrict the dispersal of sediment and/or turbid runoff generated by dewatering. These mitigation measures shall be inspected daily to ensure integrity is maintained.

G. The Water Quality Monitoring Plan (November 2018) or subsequent approved amendments must be complied with in determining the water quality baseline for the area. Turbidity (measured in NTU), Dissolved Oxygen, Clarity (measured by Secchi disk) and pH readings are to be taken in-situ, at one (1) meter below sea surface and one (1) meter about the seafloor (where possible) for a maximum depth of thirty (30) meters, **weekly** at six (6) sampling locations within the PLEM footprint and two (2) control sites for **two (2) months** prior to the start of construction, as detailed in the Water Quality Monitoring Plan (November 2018). Baseline information will be used to assist in determining correlations between construction and ambient conditions. Finally, data will also be collected on the recorder's name, date, the start and stop time, the location (GPS coordinates), wind direction/speed, wave height/direction and rainfall **during the collection of baseline data and throughout the entire project**. All data and information documented **must** be submitted to DEP on a **weekly basis**.

H. An Environmental Monitor must be present at the site **during all near/in-water activities** (in-water activities to include trenching, filling, pipeline installation, anchor placement and pile driving). The **Environmental Monitor must notify Limetree Bay Terminals and the DEP as soon as possible, but within 24 hours of exceedence**, if at any time during water quality does not comply with the Virgin Islands Water Quality Standards of 3 NTU for Turbidity, 1 meter for Clarity, 5.0 mg/L for Dissolved Oxygen or less than 6.7 or greater than 8.5 for pH, or exceeds baseline values. In addition, construction activities must cease until turbidity falls back to ambient levels, and any available methods to reduce the impact must be implemented to allow the water quality to return to normal conditions. A representative **must** be on hand at the site at all times who has the authority to implement sediment control devices, so that problems can be solved or resolved by the monitor, Limetree Bay Terminals, DEP, and DPNR. If turbidity cannot be controlled by implementing additional measures the activity must slow down to limit introduction of fines and will have to stop every time turbidity exceeds 3 NTU to allow the water to clear. Additionally, monitoring divers **must be** on site through the pipeline installation, including the trenching, filling, placement of pipes, in order to photograph and monitor on-going activities and assist in the location of the barge to avoid impact to resources, as well as transplant additional corals if needed. In water depths greater than 100ft an ROV **must be** used to monitor the activities and to document any potential impacts. While turbidity curtains and other appropriate mitigation measures shall be installed to prevent sediment migration, in the event of weather conditions that allow for sediment to settle on any coral or sponge species, monitoring divers shall dust any corals affected by settling sediments.

I. For the duration of the project, monitoring shall be continued in accordance with the Water Quality Monitoring Plan (November 2018) or subsequent approved amendments. Four (4) samples shall be collected around the area of in-water work, at 1-meter depth below the surface and 1-meter above the seafloor in areas 30 meters deep or less. Samples shall be taken **no less than twice during an 8-hour shift and at least 4 hours apart, and samplers shall be available 24-hours per day if the project so dictates** (during in-water work to include trenching, filling, pipeline installation, anchor placement and pile driving). Sample sites will be adjacent to the current area of work, and if two areas of work are ongoing, two sets of samples will be collected, and both areas will be monitored. Sample will be taken outside of turbidity barriers and in a radial pattern surrounding the activity. An additional sample will be taken twice daily within the transplant site to ensure water quality is not being affected. Additionally, wind speed and direction; wave height and direction; and rainfall shall also be recorded during each sampling event. The individual(s) recording the data collected are required to document in indelible ink and keep in a bound log book with pre-numbered pages the recorder name, date, the start and stop time, the location (GPS coordinates), and sea conditions. All data and information documented **must** be submitted to DEP on a **weekly basis.**

J. In accordance with the Water Quality Monitoring Plan (November 2018), during the trenching, divers will identify any large loose rocks or piles of material which have fallen outside the trench and have the trenching contractor remove them. Once the trenching has moved out of the area, divers will collect smaller rocks and cobbles and place them in baskets to be removed from the water and disposed in an upland area. As the divers move along, if fine sediments have collected in the trench, divers will use small plastic bristled brushes and slowly scrape the material into a pile; it can then either be placed by hand and/or swept in to a bag which can be sealed, placed in a basket and lifted to the surface. It is critical that the bags be placed in a basket for removal to the surface to prevent bags breaking or opening and spilling the fines. In order to prevent impact to critical habitat in the future caused by the open trench, if it were to undermine or contain rocks or fines that could be washed out, the trench will be surveyed by divers as soon as the pipelines and mattresses have been placed. Any small loose rocks or small piles of fine material will be removed by divers. Divers will collect smaller rocks and cobbles in the same fashion as noted above and place them in baskets to be removed from the water and disposed in an upland area. Larger areas with fine material will be cemented or grouted to leave the trench with a solid or consolidated floor.

K. Limetree Bay Terminals and its contractors **must** adhere to all established requirements related to sea turtles for lighting and acoustic impact minimization and protected species protection. A 500-m safety zone shall be established around the project area for sea turtles and marine mammals. Trained observers shall be used to visually monitor the safety zone for at least 30 minutes prior to beginning all noise creating in-water activities and throughout the day during such activities. If at any time a sea turtle or marine mammal is observed in the safety zone the operation shall be shut down until the animal has left the safety zone of its own volition. Observations for protected species shall occur at least twice a day to maintain watch for animals in the area. If at any time an animal is observed in the safety zone during the noise creating in-water activity, work shall cease until the animal has left the area of its own volition, or coordination with a DPNR representative has occurred, if the animal is injured. Limetree Bay Terminals and/or contractors **must** record all sea turtle and mammal sightings in the project area. If sighted, within the project area, the following information must be recorded: date, time, weather conditions, species identification, approximate distance from dredging area, direction, heading in relation to dredging area and behavioral observations. When animals are observed in the safety zone, additional information and corrective actions taken such as a shutdown of trenching equipment, duration of the shut-down, behavior of the animal, and time spent in the safety zone will be recorded. All data collected is to be submitted to DPNR (CZM, DEP & DFW), NFMS, LIMETREE BAY TERMINALS, FWS and ACOE in a report format on **a monthly basis.**

L. The Minimization and Compensatory Mitigation Plan (November 2018) must be complied with to ensure that the amount of corals, sponge, other sessile life forms and seagrass lost during this project is minimized throughout the project. In accordance with the Minimization and Compensatory Mitigation Plan (November 2018) or subsequent approved amendments/plans, the footprint of the final pipeline route shall be marked prior to the start of construction. The construction footprint of the initial section extending from the jetty (approximately 70' in length) may be 65' wide coming off the jetty, therefore all the corals, including the ESA listed *Acropora palmata*, throughout this initial section along the route which are within 50' of the centerline of the route shall be transplanted (estimated at 20 corals). These corals will be transplanted to the recipient site to the west and south of Ruth Island as noted in the Minimization and Compensatory Mitigation Plan (November 2018). For the next section, approximately 988', in which the pipelines will be surface lain, and have an impact area of approximately 19.6' in width, corals within 20' of either side of this section shall be transplanted (estimated at 920 corals). For the section of trenching work in the channel in which the pipelines will be buried and have an impact area of approximately 31' in width and 470' in length, corals within 50' of either side of this section shall be transplanted (estimated at 740 corals). Including transplant of an estimated 40 additional corals that may be encountered beyond the western channel wall, where the seafloor transitions into a pavement with a sand veneer, a total of an estimated 1,760 corals is expected to be transplanted as encountered. In the potential area of disturbance at the transition into the channel, it is possible that an *Orbicella* was overlooked in the potential disturbance footprint which is 65ft in width and transplant footprint 100' in width. Six (6) *Orbicella* may occur in the potential area of impact based on their densities on the pavement. If *Orbicella* or any other ESA coral is encountered, the applicant will transplant them out of the impact footprint to ensure their survival. Additionally, the pipelines along the western shelf will impact areas of dense algae colonization and areas with scattered sponges and soft corals and the placement of the PLEM may impact a few scattered sponge species. Any soft corals or sponge species within the project area shall be transplanted as encountered. **As per the requirement of the CZM permit, Limetree Bay Terminals will give 10% of the corals, which must be transplanted out of the impact footprint, to The Nature Conservancy (TNC) for their nurseries.**

M. Of these approximately 1,760 corals (or the number to be approved by the regulatory agencies), in addition to any soft corals or sponge species within the project footprint, approximately 1081 corals shall be replanted in the proposed recipient site near Ruth Island. Divers shall collect those corals and sessile invertebrates that colonize cobbles and rocks within the transplant footprint, wear disposable gloves while working with corals and keep any coral that appear unhealthy or diseased away from other corals. If a coral is handled that appears unhealthy or diseased gloves shall be changed prior to working with other corals. Individual corals, including small head and plate corals that are attached to the pavement shall be removed with chisels. The corals shall be placed in underwater bins and these bins shall be used to relocate the corals. Once the basket is full it shall be carried by the diver over to the transport tray or into a transport bucket. The transport tray will be attached to the underside of the vessel so that corals may be transported to the recipient site. Once the tray is full it will be lifted beneath the boat and at idle speed carried to the relocation site. The relocation site is on the west and south sides of Ruth Island. Once on site the tray will be lowered near the seafloor and divers will remove the corals from the tray. These corals will then be fixed in placed in their new locations with either two-part underwater epoxy, which sets in a matter of minutes (Slashzone) or hydraulic cement. The base of the coral will be carefully cleaned with a wire brush and the new substrate will be cleaned to remove algae and any other material which might interfere with the adhesion of the epoxy or cement. The coral will be carefully placed in its new place on the pavement and held until the epoxy or cement starts to set. If sea conditions are rough enough that there is difficulty using the underwater tray the corals will be moved in the transport buckets which will be hoisted on to the boat keeping the corals in water all the way to the transplant where they will be lowered to the seafloor for replanting. Extra pieces of pavement and rock left over from the trenching activities shall be left in the side cast area and be collected by divers to create an artificial reef structure in the area which has been cleared of corals. Limetree Bay Terminals will install 2 buoys in order to protect the transplanted species at the Ruth Island site.

N. Once the corals, including any soft corals or sponge species, are transplanted into the new location(s), **biweekly surveys shall be conducted for first two months** to ensure that the corals have not become unattached or shifted. If for any reason the corals become loose or move, they shall be re-situated and/or reattached. In total, twenty-five percent of the transplanted corals representative of all the species and all sizes classes of corals relocated shall be marked with numbered tags for monitoring (440). At least 10 colonies of each species, and all of the species if there are less than 10, shall be monitored. Twenty-five percent of corals encompassing the same species and size class already at the transplant site will also be monitored as controls. Once the initial two-month period is over the corals shall be monitored **on a monthly basis for the remainder of the first year and then bi-monthly for the following two (2) years and then bi-annually for the final two (2) years of the five (5) year monitoring period**. Approximately twenty-five percent (65) of the 250 ESA corals in the recipient will also be tagged for photographs on a monthly basis for the reports, but 100 percent of the ESA corals will be monitored every month and any change or demise will be reported. Maintenance shall also continue throughout this time to ensure that corals reattach to the new substrate. All photographs taken shall include location and scale as well as the description of the health of the corals photographed. If at any time during the monitoring degradation of the corals is noted, these corals shall be compared to those within the other monitoring quadrats and corals in areas outside the impact area of the transplant project. This information shall be used to determine whether the degradation of the corals is due to the transplant, activities. If the corals appear to be stressed due to the transplant, the reason shall be assessed: poor positioning, sand scour, light attenuation, etc. If necessary, the coral shall be repositioned. Every effort shall be made to save the coral. If the degradation is seen both in the project area non-transplanted corals and the transplanted corals, the reason of the demise shall be assessed. Data shall also be collected on the recorder's name, date, the start and stop time, the location (GPS coordinates), wind direction/speed, wave height/direction and rainfall shall also be collected **during the collection of baseline data and throughout the entire project**. Finally, all data collected is to be submitted to DPNR (CZM, DEP & DFW), NFMS, LIMETREE BAY TERMINALS, FWS and ACOE in accordance with the monitoring schedule prescribed above.

O. As detailed in the Minimization and Compensatory Mitigation Plan (November 2018), Limetree Bay Terminals will be doing additional compensatory mitigation through an out planting of 1,405 *Acropora palmata*, and 1,545 *Acropora cervicornis*. A portion of this out planting will be done in the St. Croix East End Marine Park (EEMP). The proposed location of the proposed-out planting will be approximately 6.25 miles to the east of the project site off Great Pond. Limetree Bay Terminals also proposes collection of 500 ESA listed coral fragments from other areas in St. Croix and the U.S. Virgin Islands (corals of opportunity). Half of the collected corals (250) would be transplanted into the enhancement site adjacent to Ruth Island; half of the collected ESA listed coral fragments (250) would be donated to the TNC to re-establish their coral nurseries. Monitoring to ensure that the corals have not become unattached or shifted should follow a similar schedule as detailed above in Condition N above.

P. Any device that emits air pollution throughout the duration of the entire project may require Air Pollution Control Permit(s), i.e. generators and barge equipment. A Dust Control Plan may also be required by DEP-Air Pollution Control Program; this plan should describe the applicant's means of mitigating dust during dredging and dewatering activities. Ms. Verline Marcellin, Environmental Program Manager of APC, can be contacted at (340) 773-1082 if further information is required on these issues.

Q. Unless specifically stated, the Applicant shall adhere to all provisions set forth in the submitted Environmental Assessment Reports (July 2017); as well as, all related plans (or approved amendments) as submitted to the Department of Planning & Natural Resources.

R. DPNR-DEP reserves the right to revise/amend this Water Quality Certificate.

S. Spill containment materials as well as a copy of the Spill Prevention Control and Countermeasures (SPCC) Plan must be kept on the premises at all times.

T. The general working area should remain clean at all times. All dredged materials generated during the execution of the project shall be kept in the properly constructed spoils area. All other waste materials generated during the project shall be kept in appropriate waste containers. At completion of work, all construction debris must be removed from the site. The seafloor composition in the sloped channel area is a pavement composed of broken coral and limestone. This material will be removed and disposed of in the old borrow pit to the north of the airport as noted in the Water Quality Monitoring Plan (November 2018).

U. The Applicant shall notify CZM and DEP at least 48 hours prior to the commencement of any development activities. In addition, a letter of project completion must be submitted to DPNR-DEP no later than ten (10) business days after the project has been completed.

V. With eight (8) weeks after project completion, a final report shall be due to DPNR which provides a critical review of observed water quality degradation and any biological impacts from the project, to include status of Mitigation Plan.

W. The monitoring reports for the various transplanted species **must** be filed with DPNR's Divisions of Coastal Zone Management, Fish & Wildlife and Environmental Protection in accordance with **Condition N above**.

9. APPROVED BY:

Kathlyn P. Worrell-George, Director
DPNR-Division of Environmental Protection

2/6/19
Date

SELF-CERTIFICATION STATEMENT OF COMPLIANCE

Permit Number: SAJ-2017-00416 (SP-JCM)

Permittee's Name & Address (please print or type):______________________________

____

____

Telephone Number: ____

Location of the Work:____

Date Work Started:__________________ Date Work Completed:__________________

PROPERTY IS INACCESSIBLE WITHOUT PRIOR NOTIFICATION: YES ______ NO_______

TO SCHEDULE AN INSPECTION PLEASE CONTACT ___________________________
AT _________________________

Description of the Work (e.g. bank stabilization, residential or commercial filling, docks, dredging, etc.):____

____

____

Acreage or Square Feet of Impacts to Waters of the United States: ____________________

Describe Mitigation completed (if applicable): _______________________________________

____

____

Describe any Deviations from Permit (attach drawing(s) depicting the deviations):

____

____

****

I certify that all work, and mitigation (if applicable) was done in accordance with the limitations and conditions as described in the permit. Any deviations as described above are depicted on the attached drawing(s).

____
Signature of Permittee

____
Date

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

02/12/2019

F/SER31:MA
SER-2018-19292

Sindulfo Castillo, Chief, Antilles Permits Section
Jacksonville District Corps of Engineers
Department of the Army
Fund. Angel Ramos Annex Bldg., Suite 202
San Juan, Puerto Rico 00918

Re: Limetree Bay Terminal Single Point Mooring, St. Croix, USVI, (SAJ-2017-00416 (SP-JCM)) Draft Biological Opinion

Dear Mr. Castillo:

Enclosed is the National Marine Fisheries Service's (NMFS') biological opinion based on our review of the U.S. Army Corps of Engineers' (USACE) proposed action to issue a permit to Limetree Bay Terminals, LLC ("applicant") for the installation of a single point mooring project used for offshore offloading of liquid petroleum products from Very Large Bulk Carriers (VLBCs). In accordance with Section 7 of the Endangered Species Act (ESA) of 1973, the draft opinion analyzes the project's effects on the endangered hawksbill and leatherback sea turtles; blue, fin, sei, and sperm whales; and the threatened green and loggerhead sea turtles; scalloped hammerhead and oceanic whitetip shark; giant manta ray; and elkhorn, staghorn, pillar, lobed star, mountainous star, boulder star, and rough cactus corals; and designated critical habitats for elkhorn and staghorn corals. It is based on information provided by USACE, the applicant, state and federal agencies, and the published literature cited within. It is NMFS' opinion that the action, as proposed, is not likely to adversely affect hawksbill, leatherback, green, and loggerhead sea turtles; blue, fin, sei, and sperm whales; scalloped hammerhead and oceanic whitetip shark; giant manta ray and Nassau grouper. Furthermore, it is NMFS' opinion that the proposed project is likely to adversely affect but not likely to jeopardize the continued existence of elkhorn, staghorn, pillar, lobed star, mountainous star, boulder star, and rough cactus corals, or destroy or adversely modify designated critical habitat for elkhorn and staghorn corals.

We appreciate USACE's efforts to identify and resolve the many technical and conservation issues associated with this project. We look forward to further cooperation with you on other USACE projects to ensure the conservation and recovery of our threatened and endangered marine species. If you have any questions regarding this consultation, please contact Melissa Alvarez, Consultation Biologist, at (954) 262-3772, or by email at melissa.alvarez@noaa.gov.

Sincerely,

CRABTREE.ROY.E.DR.1365849559 Digitally signed by CRABTREE.ROY.E.DR.1365849559 Date: 2019.02.12 14:41:35 -05'00'

Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

File: 1514-22.F.9
Ref: SER-2018-19292

Endangered Species Act - Section 7 Consultation
Biological Opinion

For the

Construction and Operation of the Limetree Bay Terminals, LLC Single Point Mooring, St. Croix, U.S. Virgin Islands

NMFS Consultation Number: SER-2018-19292

Federal Action Agency: U.S. Army Corps of Engineers, Jacksonville District

Summary of NMFS' Determinations:

ESA-Listed Species and Critical Habitat	ESA Status of the Species	Is the action **Likely to Adversely Affect** this species or critical habitat?	Is the action **Likely to Jeopardize** this species?	Is the action likely to **Destroy or Adversely Modify** critical habitat for listed species?
Hawksbill sea turtle	E	No	No	N/A
Green sea turtle North Atlantic Distinct Population Segment (DPS)	T	No	No	N/A
Green sea turtle South Atlantic DPS	T	No	No	N/A
Loggerhead sea turtle, Northwest Atlantic DPS	T	No	No	N/A
Leatherback sea turtle	E	No	No	N/A
Blue whale	E	No	No	N/A
Fin whale	E	No	No	N/A
Sei whale	E	No	No	N/A
Sperm whale	E	No	No	N/A
Nassau grouper	T	No	No	N/A
Scalloped hammerhead shark (Central Atlantic and Southwest Atlantic DPS)	T	No	No	N/A
Oceanic whitetip shark	T	No	No	N/A
Giant manta ray	T	No	No	N/A
Elkhorn coral	T	Yes	No	No
Staghorn coral	T	Yes	No	No
Pillar coral	T	Yes	No	N/A

Lobed star coral	T	Yes	No	N/A
Mountainous star coral	T	Yes	No	N/A
Boulder star coral	T	Yes	No	N/A
Rough cactus coral	T	Yes	No	N/A
E = Endangered; T = Threatened				

Consultation Conducted By: National Marine Fisheries Service (NMFS)
Southeast Region

CRABTREE.ROY.E.DR.1365849559 Digitally signed by CRABTREE.ROY.E.DR.1365849559 Date: 2019.02.12 14:42:05 -05'00'

Issued By:

Roy E. Crabtree, Ph.D.
Regional Administrator

Date: 02/12/2019

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LIST OF ACRONYMS

ARP - Acropora Recovery Pan
CFMC – Caribbean Fishery Management Council
CRCP – Coral Reef Conservation Program
CZM – Coastal Zone Management
cSEL – cumulative Sound Exposure Level
DEP – Division of Environmental Protection
DPNR – Department of Planning and Natural Resources
DPS – Distinct Population Segment
DWH – Deepwater Horizon
EEZ – Exclusive Economic Zone
EPA – Environmental Protection Agency
ESA – Endangered Species Act
FMP – Fishery Management Plan
HCD – Habitat Conservation Division
ITS – Incidental Take Statement
IUCN – International Union for the Conservation of Nature
MSL - Mean Sea Level
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
NOS – National Ocean Service
NRC – National Response Corporation
NTU - Nephelometric Turbidity Units
PLEM – Pipeline End Manifold
PRD – Protected Resources Division
REA - Resource Equivalency Analysis
RC – Restoration Center
RPM – Reasonable and Prudent Measure
SEFSC – Southeast Fishery Science Center
SEL – Sound Exposure Level
SPM – Single Point Mooring
TNC – The Nature Conservancy
TCRMP - Territorial Coral Reef Monitoring Program
USACE – U.S. Army Corps of Engineers
USCG – U.S. Coast Guard
USFWS – U.S. Fish and Wildlife Service
USVI – U.S. Virgin Islands
VI – Virgin Islands
VIPA – Virgin Islands Port Authority
VLBC - Very Large Bulk Carriers

UNITS OF MEASUREMENTS

ac	acre(s)
ft	foot/feet
ft^2	square foot/feet
in	inch (es)
km	kilometer(s)
km^2	square kilometer(s)
m	meter(s)
mi	mile(s)
mi^2	square mile(s)

1. INTRODUCTION

Section 7(a) (2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. §1531 *et seq.*), requires that each federal agency "insure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species." Section 7(a) (2) requires federal agencies to consult with the appropriate Secretary in carrying out these responsibilities. The National Marine Fisheries Service (NMFS) Protected Resources Division (PRD) and the U.S. Fish and Wildlife Service (USFWS) share responsibilities for administering the ESA.

Consultation is required when a federal action agency determines that a proposed action "may affect" listed species or designated critical habitat. Consultation is concluded after NMFS determines that the action is not likely to adversely affect listed species or critical habitat or issues a Biological Opinion ("Opinion") that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify critical habitat. The Opinion states the amount or extent of incidental take of the listed species that may occur, develops measures (i.e., reasonable and prudent measures - RPMs) to reduce the effect of take, and recommends conservation measures to further the recovery of the species. Notably, no incidental destruction or adverse modification (DAM) of designated critical habitat can be authorized, and thus there are no RPMs—only reasonable and prudent alternatives (RPAs) that must avoid destruction or adverse modification. RPAs are also developed if the Opinion finds that the action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify designated critical habitat.

This document represents NMFS's Opinion based on our review of the impacts associated with the construction and operation of the Limetree Bay Terminals, LLC Single Point Mooring located on the south shore of St. Croix at 1 Estate Hope, Christiansted, St. Croix, U.S. Virgin Islands. This Opinion analyzes the project's effects on threatened and endangered species and designated critical habitat in accordance with Section 7 of the ESA. We base our Opinion on project information provided by the U.S. Army Corps of Engineers, Jacksonville District (USACE), Limetree Bay Terminals, LLC and its consultants, and other sources of information, including the published literature cited herein.

2. CONSULTATION HISTORY

The consultation history for this project is as follows:

- On November 2, 2017, USACE submitted an email request to NMFS for pre-consultation technical assistance. NMFS sent an email response to USACE on November 3, 2017, stating our concerns regarding avoidance and minimization of impacts to ESA listed corals and coral critical habitat prior to USACE issuing the public notice.

- A public notice for the project was issued by the USACE on November 8, 2017.

- NMFS sent an email response on February 1, 2018, stating our concerns regarding impacts to colonized hard bottom, coral reefs, as well as ESA-listed species, and coral critical habitat.

- NMFS received a request for consultation from USACE on May 3, 2018.

- After the initial review of the submitted documents, NMFS issued a request for additional information (RAI) via a letter on July 13, 2018.

- NMFS received a response to the July 13, 2018 RAI on July 23, 2018. Upon further evaluation of the RAI response, NMFS determined that additional information would be required.

- NMFS participated in an interagency conference call on August 10, 2018, between NMFS PRD, NMFS Habitat Conservation Division (HCD) and USACE, to discuss the adequacy of the applicant's response to the NMFS's RAI.

- NMFS PRD and HCD participated in a conference call on August 16, 2018, with USACE and the applicant, to discuss current project scope, permitting status, consultation status, the applicant's response to the RAI, and the applicant's mitigation plan.

- On August 17, 2018, USACE issued minutes to the August 16, 2018 meeting and identified the additional outstanding information required to initiate the consultation.

- NMFS provided clarifying comments to USACE on the meeting minutes from the meeting on August 16, 2018, via email on August 20, 2018.

- On August 31, 2018, USACE provided 3 emails to NMFS with the applicant's response to our outstanding questions.

- NMFS reviewed the provided information from August 31, 2018, determined the consultation request sufficiently complete, and initiated the consultation that same day.

- NMFS, USACE, and the applicant's agent met on September 26, 2018, to discuss additional questions from NMFS. Since September, NMFS and the applicant's agent have met at least weekly to discuss the project and further clarify information needed in order to complete the biological opinion.

3. DESCRIPTION OF THE PROPOSED ACTION

The proposed Single Point Mooring (SPM) liquid petroleum transfer project is be located at the Limetree Bay Marine Terminal (Limetree), 1 Estate Hope, Christiansted, St. Croix, U. S. Virgin Islands (USVI), which is on the south-central coast of St. Croix (see Figure 1). The land-based operation of the Limetree facility is the location of the former Hovensa Oil Terminal Facility. The proposed SPM will be located offshore at 17.687756°N, 64.740337 °W North American Datum 1983 (NAVD 83), in 665 feet (ft) of water. The project will install a SPM and an underwater pipeline system for the offshore transfer of liquid petroleum products from Very Large Bulk Carriers (VLBCs) to the existing facilities at Limetree. This proposed project would allow Limetree the ability to receive shipments from VLBCs with drafts up to -76 ft below mean sea level (MSL) without docking at the land-based operations or having to transfer fuel to smaller vessels. The VLBCs would moor to the SPM in deep water (>600 ft), connect to the suspended hose lines that are attached to the pipelines, and off load their products through the transfer system.

Figure 1. Project Area Location

The project will include the placement of 2, 30-inch (in) diameter pipelines (steel pipes encased with 3-in of concrete) laid parallel from the end of the eastern jetty (see Figure 2) of the Limetree Bay Terminal to a Pipeline End Manifold (PLEM) to be located offshore at a water depth of 136 ft below MSL. Two sections of the parallel pipelines will be placed on the surface of the marine floor, while two other sections would require excavating trenches to allow for the bend radius of the pipelines as they transition off the jetty and as they transition across the channel. The installation of the pipeline, including the surface-laid and trenched sections, will be completed in approximately 10 days. At the end of the pipelines, the PLEM is used to transition the pipelines to two 24-in in diameter hoses, which will continue seaward suspended mid-water between 135 ft and 250 ft to the SPM. The SPM will be balanced between all of the mooring anchors, in order for it to stay in position through all weather conditions and sea states, otherwise referred to as the buoy balance position. An overview of the project and the locations of the pipelines, PLEM, and SPM is shown in Figure 3.

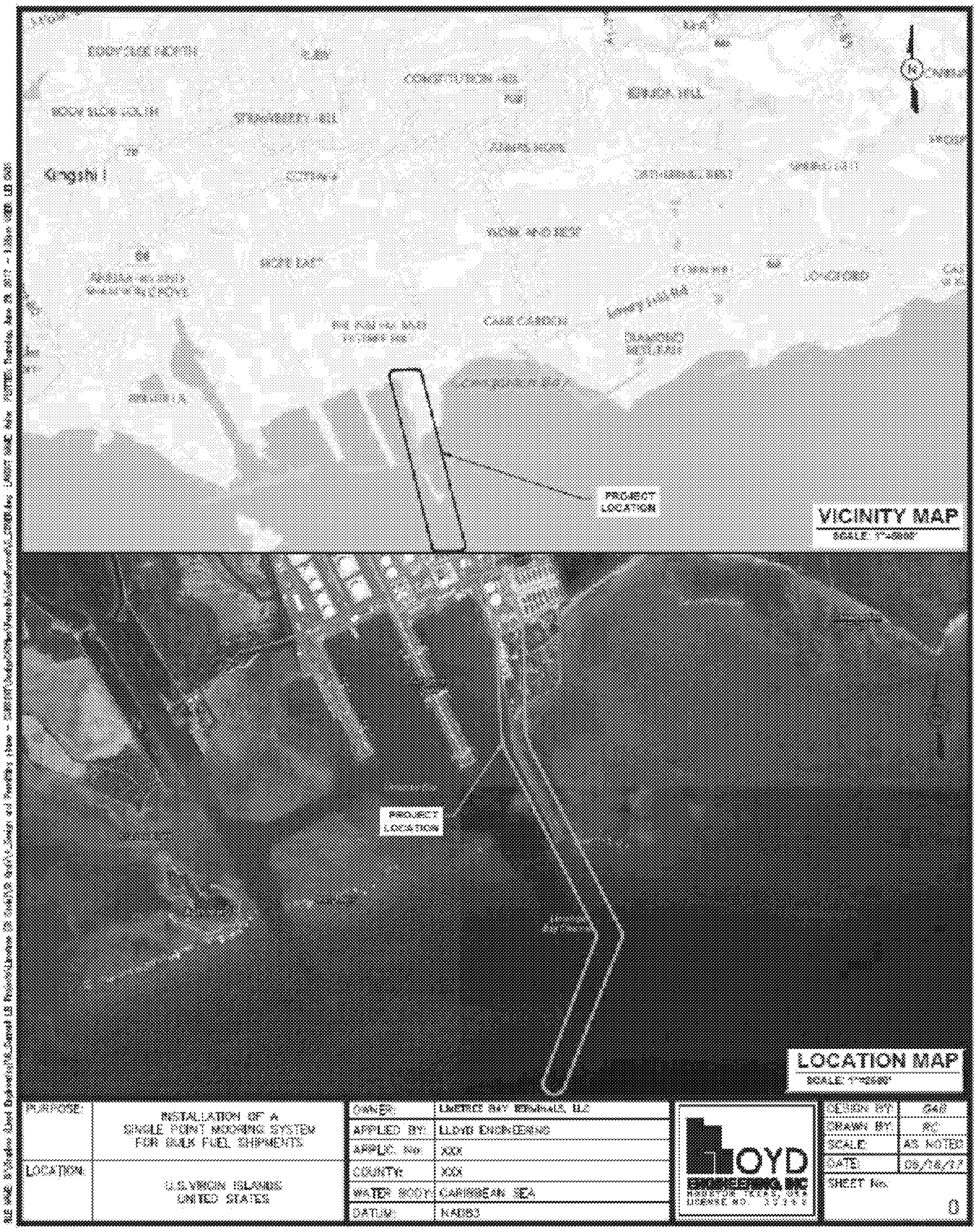

Figure 2. Project Location Map

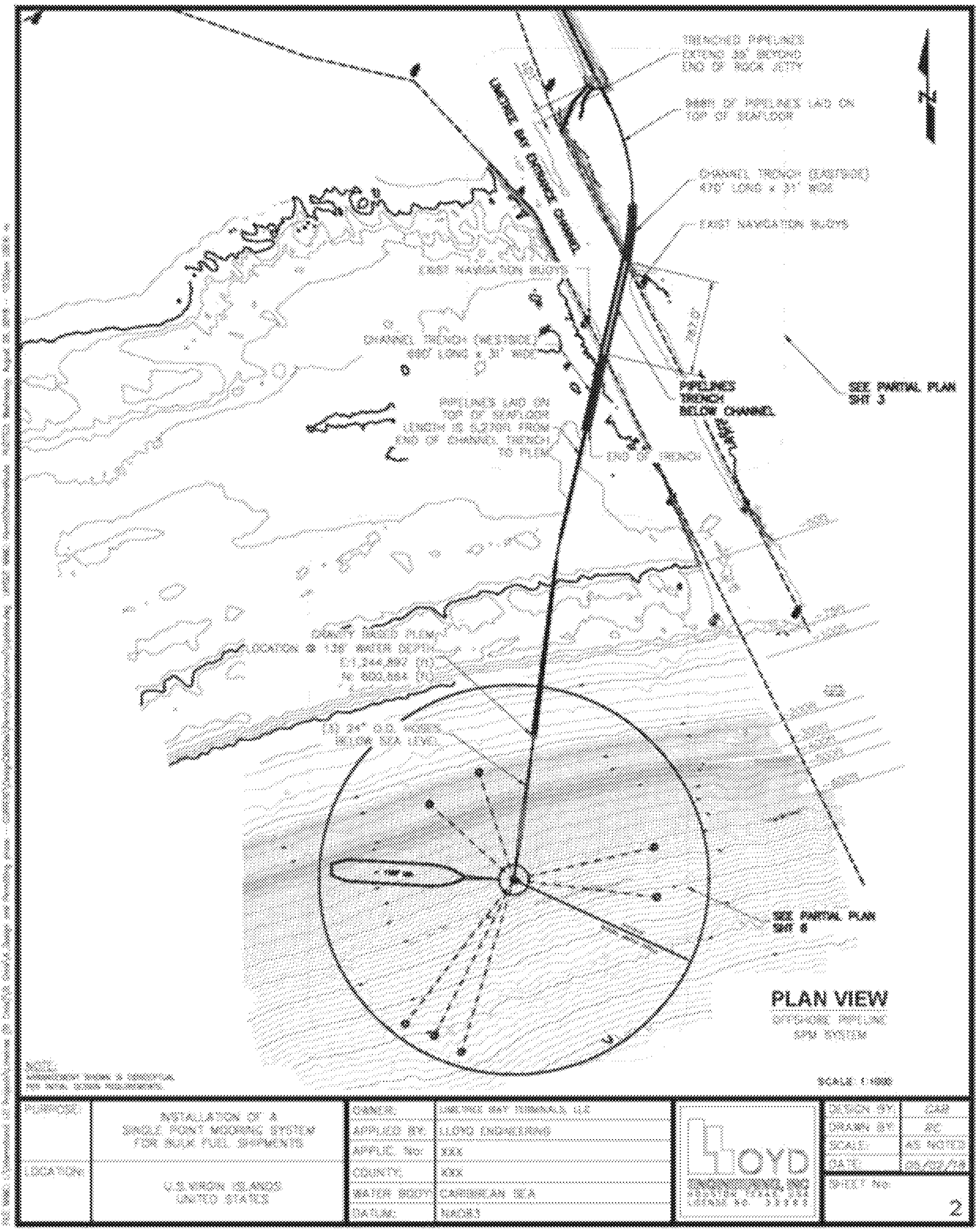

Figure 3. Project Overview Showing Pipelines, PLEM, and SPM

In order to delineate the mooring area around the SPM, a navigation buoy will be placed at a depth of 100 ft adjacent to the pipelines in an area of uncolonized sand. This marker buoy will indicate where the pipelines are located so that ships can avoid this area during maneuvers in the channel. Two additional channel marker buoys will be installed on either side of the channel crossing to alert vessels and their pilots where the pipelines cross the channel to avoid damage to the pipelines by anchoring. Channel marker buoys will be lit with standard buoy lighting. The buoys and anchors will consist of poured concrete blocks measuring 2-ft-by-2-ft-by-2-ft attached to the buoy with a steel ring. The anchor blocks will be poured on shore, taken out with a tug, and placed by divers using lift bags. The two channel markers will be placed within the 31-ft disturbance footprint for the channel trenching further described in Section 3.2.

3.1 Project Site Preparation

Prior to the start of construction, the final pipeline route will be marked and Limetree will remove all non-ESA-listed corals from the expected impact areas on either side of the pipeline sections. These non-ESA listed corals will then be transplanted at the coral mitigation enhancement site. Any mountainous star corals found during this removal, will also be relocated. The mountainous star corals will be transported to the Nature Conservancy (TNC) coral nursery at Cane Bay, St. Croix, USVI, and held there until the construction is complete. Once construction is complete, any mountainous star coral being held at TNC nursery will be outplanted within the Action Area. Coral collection, relocation, use of the TNC coral nursery, and transplanting with be further discussed in Section 3.7

Divers will collect corals and sessile invertebrates that colonize cobbles and rocks within the transplant footprint. Individual corals that are attached to the pavement then will be removed with chisels. Divers will wear disposable gloves while working with corals and keep any coral that appear unhealthy or diseased away from other corals. If a coral is handled that appears unhealthy or diseased, gloves will be changed prior to working with other corals. The corals will be placed in underwater baskets and these baskets will be used to transport the corals to TNC.

3.2 Pipeline Installation

Prior to deploying and installing the pipelines, the concrete pipe segments will be welded together onshore. Then pipe sections will be slowly moved into position and lowered to the marine bottom in a controlled manner using floats and flooding of the pipe. Divers and/or robots will also assist in the process. Operations will continue 24 hours a day without anchoring or spudding of the barge to minimize the potential for pipeline swing, bend, and/or damage. This will also avoid potential impacts to benthic habitats from barge anchoring or spudding, as well as from temporary laying down the pipelines on the marine floor. Support bags filled with commercially available sand will be installed underneath pipeline sections in various locations along the route to rectify unsupported pipeline spans. The support bags could vary in weight, depending on the need and location. Typically, the bag will range from 500 pounds to 2,500 pounds. The bags will be filled on the barge and lowered to the marine bottom with a crane. Once near their desired location, divers will assist with exact placement. It is anticipated that there will be approximately ten locations requiring support bags along the proposed route based on the bathymetric data analyzed. However, an actual visual inspection of the line (once installed) will confirm the exact number, size and location of support bags needed.

To install the first offshore section of the pipelines, an approximately 15-ft wide trench will be excavated at the seaward end of the eastern jetty. This will require the temporary removal of a section of the revetment of the east jetty. The revetment is composed of concrete dolos (concrete tetrapods used to prevent erosion). After the dolos are removed, the existing hardbottom ocean floor will be broken and approximately 1200 cubic yard (yd^3) of material, including broken hardbottom and sediments, will be dredged from the footprint of the trench using a land-based excavator. The excavated materials will be temporarily stored on the jetty in reinforced silt fences designed so that all runoff from the stockpile is directed back into the trench. To minimize the impact of the oncoming seas and prevent erosion during excavation, an open-ended caisson or cofferdam enclosing the excavation area will be installed.

In order to allow for the pipe bend radius, the trench will extend approximately 35 ft from the end of the existing revetment footprint. Approximately 445 yd^3 of material would be excavated from seaward of the jetty from the revetment footprint and offshore hardbottom. The trench will be between 7.5 ft and 9 ft deep in this area and 31 ft wide. Once the excavation is complete and the pipelines are placed, the upland trench in the jetty would be refilled with the same material excavated from it, and the dolos returned to their original location to protect the terminus of the jetty. The trench seaward of the revetment will not be filled, but concrete, articulating mattresses (15-ft-by-8-ft) will be placed on the pipelines within the trench. This initial pipeline section installation is shown in Figure 4. The trenching of the hardbottom seaward of the revetment footprint will be completed with a barge mounted excavator with an open bucket so that water will drain as the material is removed. The dolos will be temporarily relocated to an uncolonized area of marine floor to the southeast of the project footprint while the pipelines are installed. The dredge barges will only anchor or put down spuds within the impact corridor in preselected locations to dredge or excavate the trenches.

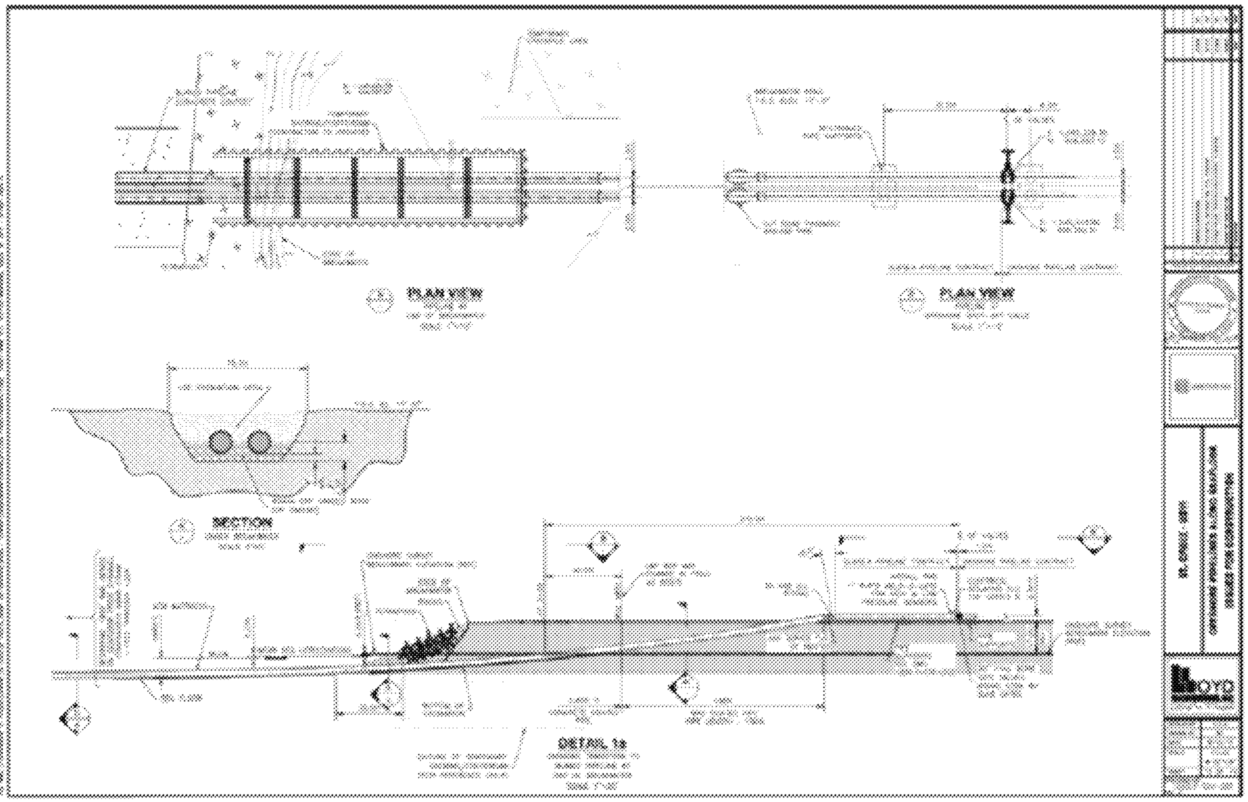

Figure 4. Pipeline Installation from the Jetty

The second section of the pipelines will be surface lain on the marine floor to the south for 988 ft before turning to the southwest to cross the Limetree Bay Terminal Navigation Channel. The surface lain portion of the pipelines will be approximately 11 ft in width. It is expected that 115 concrete articulating mattresses (25-ft-by-8-ft) will be placed on the pipelines to secure them in place to protect the sensitive habitat surrounding them from abrasion and for additional protection from groundings and anchoring.

The third section of the pipeline corridor will require excavating a trench approximately 470 ft long, 31 ft wide, and an average of 16 ft deep to accommodate the pipe bending radius into the channel. The trenches outside of the channel crossing are transition trenches and will be as shallow as possible and still achieve the intended purpose of accommodating the pipeline to bend into the channel. If necessary, up to 3 temporary piles (steel, 18 in diameter) will be installed to assist in the exact positioning of the pipelines as they curve into the channel. These piles will be placed with a vibratory hammer and will be driven into the area that will be disturbed by the trenching. The trench will then continue 787 ft across the navigation channel and 660 ft up the western channel slope. The excavation will be completed using an extended arm backhoe or a clamshell or bucket type crane excavator mounted on a barge. The channel floor is comprised of a soft unconsolidated, uncolonized material. Only the excavated material from the channel bottom will be side cast during the pipe placement. The excavated material from the channel slope trenches will be brought to the surface, loaded onto a barge, transported to the Limetree facility, and disposed/reused in the uplands based on sediment characterization analysis. Approximately 40,000 yd^3 of sediments will be excavated. Concrete articulating mattresses will be placed over the pipes and at critical areas to further protect the pipes within the trench. The excavation within the channel will ensure that the top of the pipelines will be at least 10 ft below the existing channel floor (which is 60 ft below MSL).

The fourth section of the pipelines will begin once the pipelines emerge from the channel. This section of the pipelines will be surface lain in a southwest direction for approximately 2,570 ft to a water depth of 136 ft, terminating at the PLEM. No concrete mattresses will be utilized over the pipelines in this section as it crosses over open sand. Table 1 summarizes the total area of habitat being impacted by the pipeline installation.

Table 1. Total Area of Sea Floor Habitat Impacted

Pipeline Section	Pipeline Description	Size of Impact	Total Area of Impact
Section 1	Trenching Off Jetty	15 ft wide by 35 ft long by 7.5 ft deep	525 ft^2
	15 ft x 8 ft mattresses in trench		
Section 2	Surface lain	11 ft wide by 988 ft long	10,868 ft^2
	Mattresses (115)	10.6 ft by 8 ft (84.8 ft^2) (mattresses are 25 ft by 8 ft, but only 10.6 ft will extend beyond the pipeline footprint)	9,752 ft^2
Section 3	Trenching in Channel	31 ft by 1,917 ft	59,426 ft^2
	Trenching West Slope of Channel	31 ft by 660 ft	20,460 ft^2
	Trenching East Slope of Channel	31 ft by 470 ft long	14,570 ft^2
Section 4	Surface Lain	11 ft wide x 2,750 ft long	31,363 ft^2
Total Area of Sea Floor Habitat Impacted			**146,964** ft^2

3.3 Installation of the SPM and PLEM

The PLEM will transition the pipeline system to two 1,500-ft long and 24-in diameter hoses, which will be suspended mid-water at water depths between 135 ft and 250 ft. The hoses will extend to the floating SPM (see Figure 5). Floats and weights will be used to help maintain the hoses in position. The SPM will be positioned at a water depth of 665 ft which will allow adequate depth (VLBCs draft 88 ft or more) for the tankers to swing.

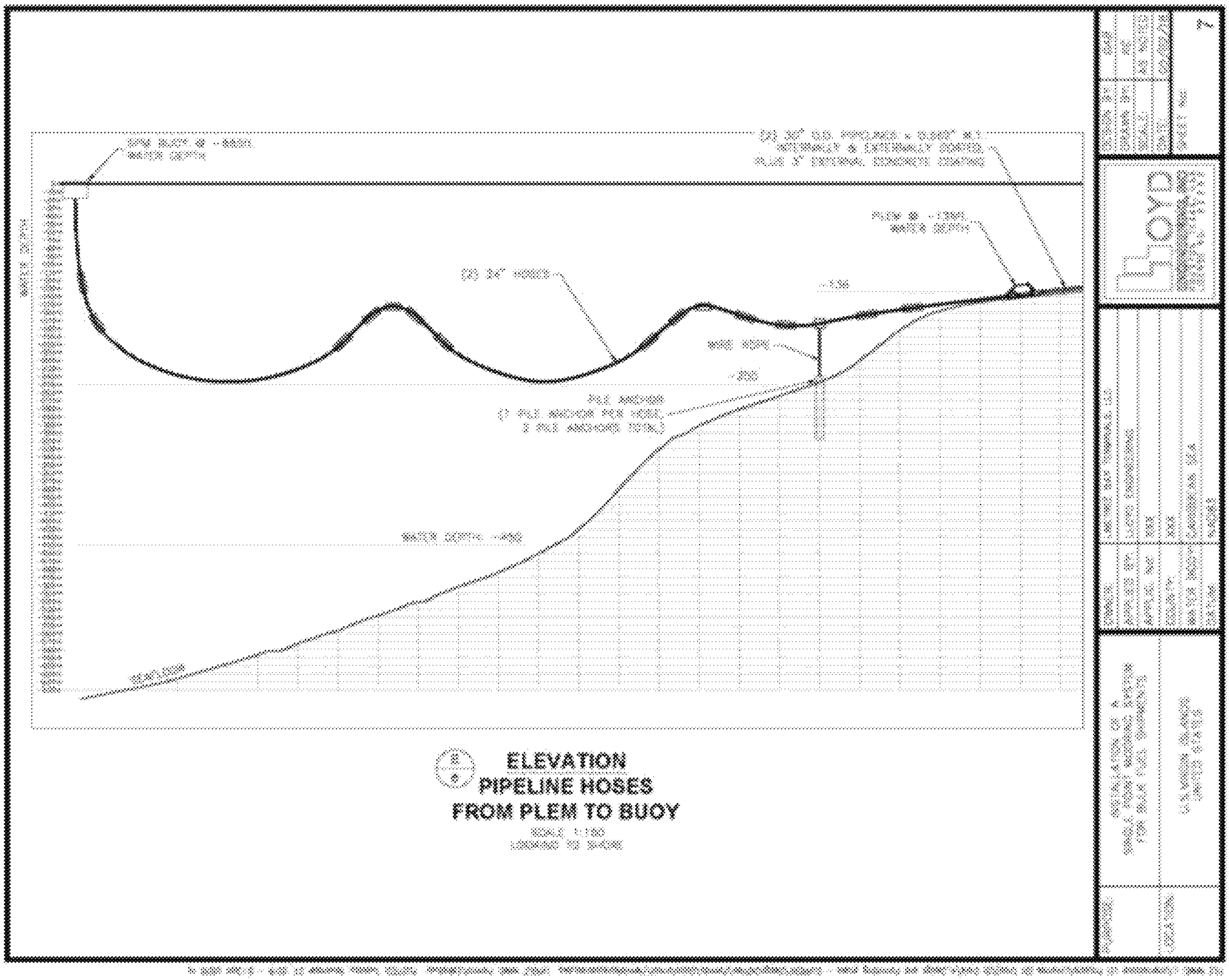

Figure 5. Project Cross Section PLEM to SPM

The PLEM will be held in place by gravity blocks. The PLEM will have a frame designed to hold 1,000 tons of concrete blocks. The steel PLEM structure will be set in place on the seafloor and the pre-cast concrete blocks will be lowered into place on the framework designed to receive them. Seven anchor piles will be used to stabilize the SPM and two steel anchor piles will be used to stabilize the 2 floating subsea hoses. The hose and SPM anchor piles will be approximately 72 in in diameter and approximately 80 ft in length. The the subsea hoses, and the SPM will be connected to their respective anchor pilings via steel chains.

The 9 anchor piles will be installed by drilling and grouting. The method of drilling and grouting piles into position is an industry wide accepted practice whenever soil conditions prohibit the conventional installation methods of driving piles with a hydraulic or other type of pile driving hammer. The process begins with the setting of a temporary support frame on the seafloor. The temporary support frame is only used as a guide and for support of the casing. The drilling string and drilling tool will be lowered from the surface into the casing and will begin to drill through the seafloor materials. The process involves no chemicals, nor does it introduce any other foreign materials to the water. The drilling will be done with a very specialized drilling equipment due to the depth of water involved. As the drilling progresses into the seafloor, the casing is lowered into the drilled hole. Upon reaching the designed depth, the drilling tool will be removed, and the actual pile will be placed inside the casing. The casing will be connected to a crane located on the surface support vessel and will be slowly retrieved from the drilled hole. As this casing removal is occurring, grout will be pumped into the annulus between the pile and the drilled hole. Each pile will require approximately 27.7 cubic yards of grout. The grout used will be calculated for each pile based on drilling and grout placement will be monitored by remotely operated vehicle (ROV) to ensure overfilling of the annulus does not occur. Once this grout has set, the pile is now secured permanently into place and ready for use. It is anticipated that it will take 2 to 3 days to drill and grout each of the 9 piles.

As shown in Figure 6 below, a restricted navigation area will be established around the SPM. The PLEM hoses and SPM will be illuminated via navigation lights on the marker buoys, to allow for clear visibility of these structures with minimal disturbance to marine life.

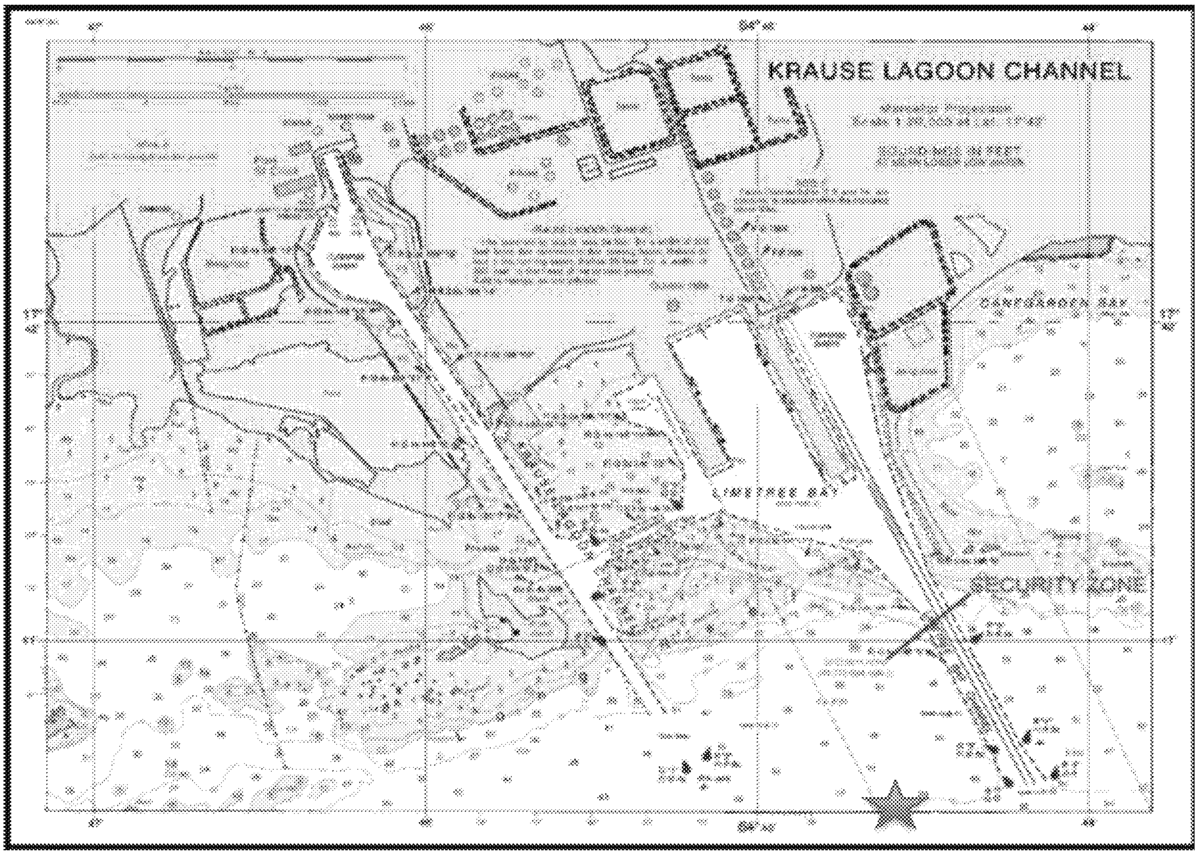

Figure 6. Excerpt from NOAA Chart (#25641 Virgin Gorda to St. Thomas and St. Croix) Showing Security Zone and the SPM (blue star)

3.4 System Operations

The SPM system operations begin with the evaluation and approval of all VLBC's during approach. VLBCs are only allowed to berth to the SPM after approval. Approval requires Limetree to evaluate the vessel, its past performance, any safety issues, prior incidents, and documentation. The vessel, once approved, will give notice of arrival at least a week prior to arriving in St. Croix. Prior to arrival of a vessel, Limetree's SPM Department will conduct the pre-berthing inspections to ensure proper operation of the SPM system. The vessel will arrive three miles (mi) off the south shore of St. Croix at a designated pilot boarding position. The Limetree Bay Pilot and Mooring Master will transit to the vessel via tugboat. The team will board the vessel, and verify vessel documentation and the pilot will then guide the vessel to approximately 50-75 ft from the buoy using the vessel and tugs to assist. The Mooring Master will be on the bow of the tanker and oversee the connection of the mooring line to the buoy. There will be two additional tugs assisting this operation, one will bring the mooring line to the tanker and one will be holding the floating hoses away from the operation. Once the mooring lines are connected from the buoy to the bow of the tanker, the Mooring Master will oversee and assist the vessel crew in connecting the floating hoses to the vessel manifold for cargo transfer. Once this is complete, the VLBC pilot will disembark with the assist tugs. The Cargo Inspector, Security Superintendent, and government officials will then board the vessel and conduct any inspections needed, as well as the pre cargo conference.

The Mooring Master will continuously monitor the entire cargo operation on board the tanker using a telemetry unit. This laptop will provide constant data on the entire operation, including the strain on the mooring lines, the pressure on the hoses, the alignment of the valves, pressure fluctuations, and many other conditions. Any change of pressure or leaks will be detected immediately and the system isolated to minimize any loss of containment. There will also be a tug on the stern of the vessel crewed with responders and stocked with spill response equipment. Once the cargo transfer is complete, there is a similar process in reverse to disconnect and move VLBCs away from the SPM. The vessels are expected to be moored for a maximum of 48 hours. VLBCs may either off load product (mainly heavy or light crude oil) or receive product at the SPM.

The VLBCs currently approach Limetree Bay for berthing by utilizing the Limetree Bay Navigation Channel. This channel is 500 ft wide and has a controlling depth of 55 ft. VLBC's have been safely berthed half loaded at the facility for the last 50 years. Limetree's pilots have a perfect record berthing crude vessels at the facility with no groundings. There is inherent risk to this evolution as the channel is 500 ft wide and these vessels are 200 ft wide. Once tugs are added to either side and the vessel is angled to offset the wind and current, the entire 500-ft channel is used to perform the evolution safely. The transfer to the land-based berth occurs over benthic coral reef resources. The SPM Project will allow the facility to berth fully loaded VLBCs with a much safer evolution.

In order to maximize safety and structural design considerations, Limetree utilized hydrodynamic and structural analysis models of the SPM, to create a full mission ship simulator. Utilizing the models, Limetree has already performed many trips to and from the buoy in all the weather conditions experienced at the site. The SPM model results indicate that the safety margin is greatly increased by the addition of the SPM. By moving the operation outside the reef, the vessel can abort the evolution at any time and safely turn to deeper water. The shallowest depth the vessel will swing in during berthing is 102 ft MSL and the SPM is 1,130 m from the nearest coral critical habitat.

To comply with the USCG Response Plans for Oil Facilities requirements under 33 CFR Part 154, and in accordance with the facility's Integrated Contingency Plan dated July 2017, the Limetree facility has two oil spill response organizations on site. National Response Corporation (NRC) and Marine Spill Response Corporation (MSRC) currently have over 45,000 feet of containment boom available on site, multiple recovery vessels, and two recovery barges. The Limetree SPM is being manufactured by Imodco who is the leading supplier of SPM buoys, with over 450 systems designed and installed worldwide since 1958. There are currently 280 Imodco designed and constructed mooring systems in operation in over 60 countries worldwide. The Limetree buoy is being constructed to American Bureau of Shipping Standards and maintained and operated per Oil Companies International Marine Forum guidelines. The marine breakaway coupling on the buoy provides an identified safe parting point in the offshore hose transfer string and automatically shuts off product flow in the event of a tanker breakout, or an extreme and damaging pressure surge incident during cargo transfer. This safeguard is not part of the current loading system on the jetty. This single feature will lower the risk of a spill by the newly constructed system compared to the existing system, and is an example of the engineering approach being utilized on the project to lower the risk profile wherever practicable.

During normal operations, there are no ballast intakes or any discharges from the moored vessels. Any ballast water that must be discharged, will be released through Limetree's ballast water treatment system. The SPM or vessel operations does not require any other discharges other than normal vessel discharges such as engine cooling water.

In accordance with USCG Facility Response Plans requirement under 33 CFR 154 and the submitted Integrated Contingency Plan dated July 2017, the Limetree facility has two oil spill response organizations at the facility. National Response Corporation (NRC) and Marine Spill Response Corporation. (MSRC) currently have over 45,000 feet of containment boom available on site, multiple recovery vessels, and two recovery barges.

3.5 Benthic Resources

ESA-Listed Species and Critical Habitat Surveys

Before selecting the proposed pipeline route, Limetree conducted an analysis of various pipeline corridors at the site. To inform this analysis, benthic surveys at the site began in January of 2017. Surveys identified habitat type, presence of corals, submerged aquatic vegetation (SAV) resources, and ESA-listed species. The surveys were accomplished with 3 divers swimming abreast, each covering an area of 5 m so that each transect covered 15 m. Below a depth of 100 ft, surveys were made with an ROV down to the depth of 1,250 ft. Once the resources were mapped, Limetree determined the route that avoided ESA-listed species, would have the least environmental impact on corals and seagrasses, and could meet engineering specifications required for the pipeline. Another benthic survey was conducted over the selected final alignment in April, May, and June 2017, 100 ft on either side of the alignment. Corals and other resources were identified, counted, and classified in two size classes (< 1 ft and > 1 ft in diameter).

In February of 2018, a geotechnical study and benthic survey was completed for the deep water anchors. The February 2018 survey confirmed that anchoring points and the 136-ft deep PLEM location was clear of all coral and hardbottom resources.

Additional benthic surveys were undertaken in April and May of 2018 to assess changes that occurred as a result of Hurricanes Irma and Maria. Those surveys determined that, no significant benthic changes or damage were in the project area.

During the original scoping for alternative pipeline corridors an overall area that included 60 ac shallower than 100 ft and 60 ac deeper than 100 ft was reviewed as potential areas for the positioning of the project. Then habitats were identified within this area to attempt to avoid hardbottom resources. A smaller area within the original area was chosen as the focus areas since it appeared to avoid the most amount of hardbottom. This was approximately 28 acres (ac) of the original shallower 60 ac. Using the data from this 28 ac, percent cover of ESA-listed corals was calculated from the total number and size class of each coral species that was noted during the surveys, then this was divided by the total area surveyed. Once the final route was chosen, only the route transect data was utilized to determine percent cover of ESA-listed species. An area of 55,250 ft^2 was surveyed and 11 colonies of mountainous star coral were observed in the surveyed area however none of these were in the pipeline or impact corridor). The density of mountainous star coral was determined to be 0.000199 per ft^2 (11 corals /55,250 ft^2).

Based on the total area of impact to coral critical habitat being 40,320 ft^2, and the observed density of mountainous star coral at 0.000199 corals per ft^2 within the surveyed areas adjacent to the pipeline route, Limetree estimates that up to 8 corals (40,329 ft^2 x 0.000199 coral / ft^2) could be present in the impacted area, although they were not found within the pipeline footprint of the surveys. Table 2 summarizes the total area of coral critical habitat being impacted for each of the four pipeline sections, as well as the total area of coral critical habitat being impacted.

Table 2 Project Impact Areas

Pipeline Section	Pipeline Installation	Total Area of Impact	Total Area of Coral Critical Habitat Impacted per Pipeline Section
Section 1	Trenching off jetty	525 ft^2	525 ft^2
Section 2	Surface Lain	10,868 ft^2	10,868 ft^2
	Mattresses	9,752 ft^2	9,752 ft^2
Section 3	Trenching of Channel	68,355 ft^2	0
	Trenching West Slope of Channel	20,460 ft^2	1,085 ft^2
	Trenching East Slope of Channel	14,570 ft^2	14,570 ft^2
Section 4	Surface Lain	31,363 ft^2	3,250 ft^2
Total Area in Square Feet		**146,964 ft^2**	**40,320 ft^2**
Total Area in Ac		**3.3718 ac**	**0.9256 ac**

3.5.1 Resource Description

The Limetree facility has revetted jetties that are moderately colonized by coral and sponge species. The coral colonization on these jetties within the dolos includes ESA-listed elkhorn, mountainous star, lobed star, boulder star, and pillar corals. Limetree Channel extends seaward from the east basin at a depth of over 60 ft. The channel is cut into limestone and steep slopes characterize the channel out to its seaward end. On the eastern side of the channel, a shallow rock pavement extends from the end of the jetty seaward. The water is only 6 to 8 ft deep off the end of the eastern jetty to up to 35 ft at the wall of the channel. The pavement is sparsely colonized by hard and soft coral species, including ESA-listed species, at the end of the jetty, but the abundance of corals and sponges increases seaward. An elkhorn coral recruit, which had not yet branched, and a small elkhorn coral (18 -in-by-18-in) were both found on this eastern pavement, about 300 ft seaward of the jetty. The dead skeletons of both elkhorn and staghorn corals are common scattered across the pavement. Approximately 300 ft off the end of the jetty, mountainous and boulder star corals start to become present in low densities and the benthic surveys revealed at least 11 colonies within the transects (see Figure 6). Algae becomes more abundant on the pavement as you move offshore.

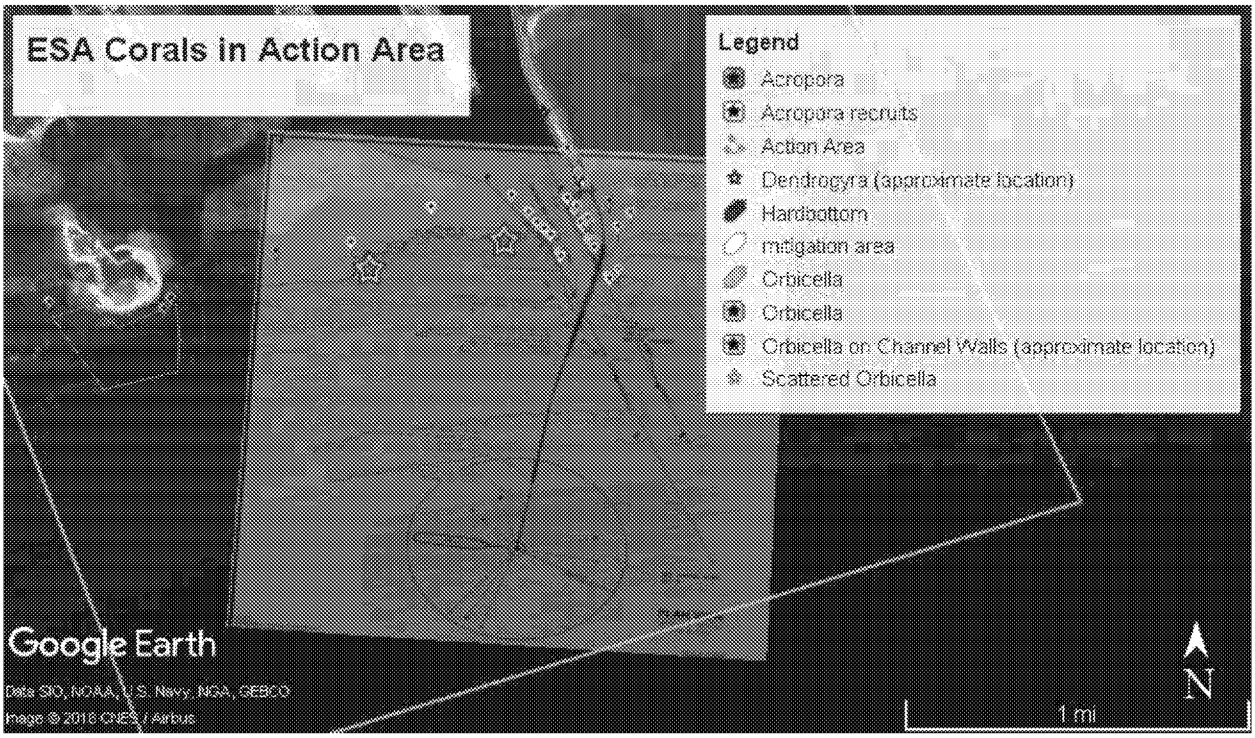

Figure 7. ESA Corals in the Action Area

The channel edges vary in slope due to the substrate integrity and stability, and depths range from 35 ft to 60 ft. The greatest coral and sponge colonization is in the upper several feet of the channel and the area closer to the channel floor is colonized primarily by algal species.

The channel bottom (about 60 ft deep) is composed of soft sediment and is uncolonized with a few scattered hydroids. The western side of the channel has what was once a well-developed reef crest located about 2300 ft off the end of the western jetty. Between the cross channel and the reef crest, there are scattered seagrass beds. Beyond the reef crest, irregular rock pavement extends off shore with a scattered sand veneer. The hardbottom and the reef crest are minimally colonized with scattered corals. There are a few areas of scattered seagrass, with a few small patches on the sand veneer south of the reef. The seagrass beds are all slightly raised above the surrounding sand plains and algal beds.

After crossing the channel, on the southern plain between 50 ft and 150 ft water depth, there are expansive algal beds, which densely covered large areas of seafloor. Between 50 ft and 150 ft water depth, the plain slopes gradually and there is intermittent sand and exposed pavement. The pavement is colonized by primarily sponges and soft corals due to its periodic coverage by sand and very few hard corals exist. The slope become steeper at approximately 150 ft water depth and it varies in angle with small intermittent rock ledges exposed between steep sand drops. The ledges are colonized by sponges, soft corals, branching sponges, hydroids and a very few hard corals. Black corals become present at 100 ft deep and are one of the most abundant species between 150 ft and 600 ft, at which time the slope becomes less severe. Below 350 ft water depth, only a few hydroids and black corals can be found.

Off the eastern jetty, the National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS) habitat map (Figure 7) shows a linear reef to the east of the jetty and an expansive pavement and pavement with channels to the south. These were identified during detailed benthic surveys. To the west of Limetree Channel and to the south of the Cross Channel, the map depicts continuous seagrass beds. While seagrass beds are present, they are not as continuous as shown in the map. The map then shows linear reef running between the two channels. This shallow reef crest is composed primarily of elkhorn and staghorn coral skeletons and has minimal colonization by live corals. The map then shows reef colonized pavement and reef colonized pavement with sand channels extending off-shore to the end of the channel. On the western side of the channel past a depth of approximately 30 ft, expansive sand flats exist. These vary in levels of colonization from algae and seagrass to uncolonized sand and sponges to soft coral colonized emergent pavement (Figure 8).

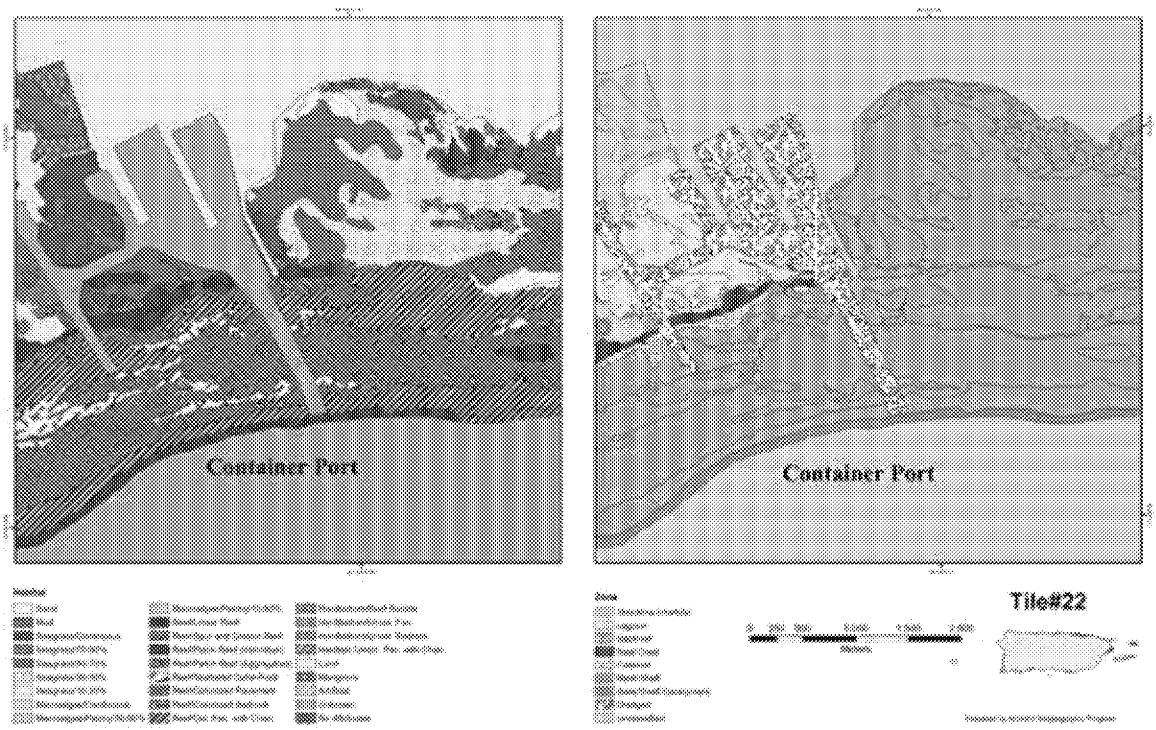

Figure 8. NOAA NOS Benthic Habitat Map Tile 22

The installation of the SPM will result in maximum impact to 40,320 ft^2 of rock pavement and hardbottom. The project will also affect 59,426 ft^2 of soft channel bottom and 31,363 ft^2 of sand.

3.6 Water Quality and Turbidity Control

The project includes the placement of two concrete coated 30-in diameter parallel pipelines from the end of the eastern jetty of the Limetree Bay Terminal to the PLEM at a water depth of 136 ft below MSL, which in turn connects to the floating SPM. Water quality maybe affected during the installation of the pipeline at locations where installation involves trenching. Trenches are required in order to allow for the bend radius of the pipelines as they transition off the jetty and as they transition into and across the channel. Limetree proposes to avoid and minimize turbidity and sedimentation impacts by using turbidity controls, and by using water quality monitoring to adaptively management impacts as described below.

3.6.1 Construction Methods and Turbidity Control

The trench at the end of the jetty will be excavated from the landward side and the material will be temporarily stored on the jetty in reinforced silt fences designed so that all runoff from the stockpile is directed back into the trench. To minimize the impact of the oncoming seas and prevent erosion during excavation, an open-ended caisson or cofferdam enclosing the excavation area will be installed. All runoff that is directed into the trench will be captured within the caisson. In order to minimize turbidity and sedimentation impacts, a double set of turbidity barriers will be installed to the west (the predominant wave and current direction) to prevent any suspended sediments from impacting the corals that have colonized the shoreline dolos and riprap (Figure 9).

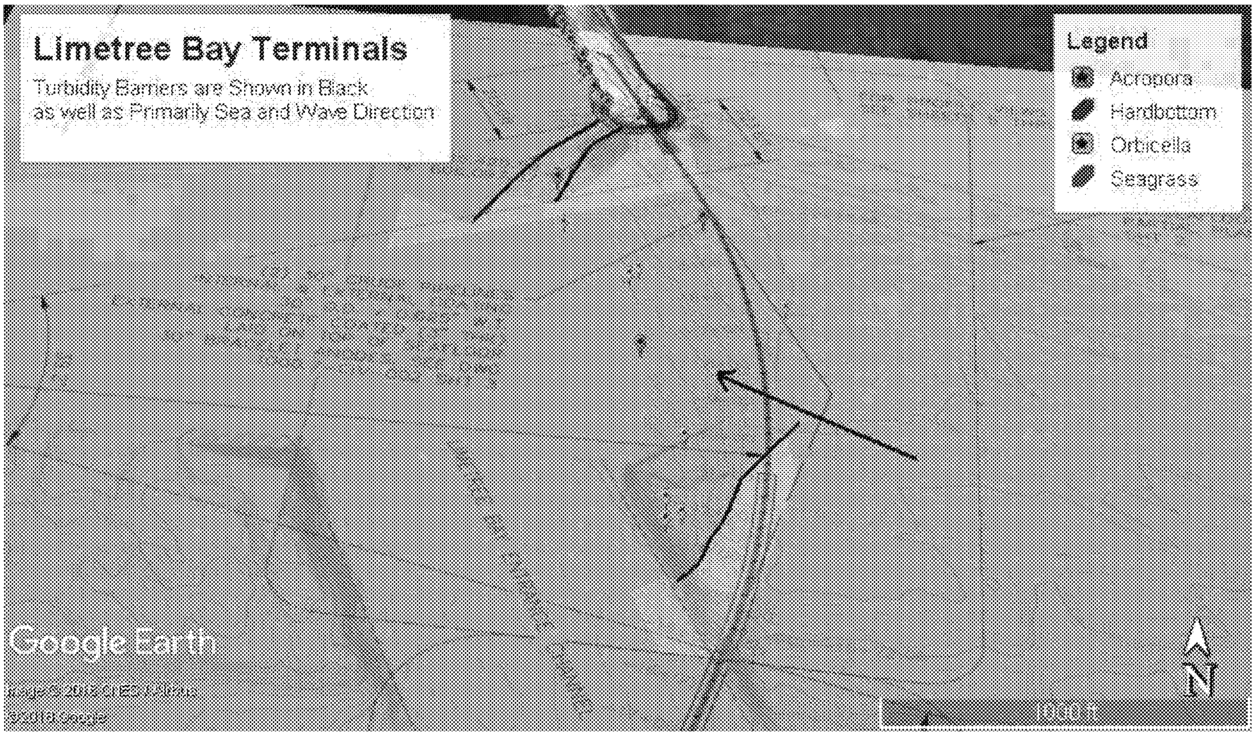

Figure 9. Locations of Turbidity Barriers

The trenching seaward of the revetment, on the rock pavement, down the channel walls and across the channel will be done by a barge mounted crane or excavator. The side of the channel material, which is rocky in nature, will be excavated, removed and dewatered on the barge with a clamshell bucket. Discharge points from the barge will be contained within double set of turbidity barriers. Additional turbidity barriers will be placed to the southwest to divert turbidity and sedimentation towards the channel, where the fines can settle in the deeper calmer water of the channel. The channel, which is soft material, will be trenched and the material will be side cast to limit the turbidity of the material being brought to the surface and dewatered.

Nine anchor piles will be used to stabilize the SPM and PLEM. Three temporary steel piles will be used to assist in the installation of the pipeline. The anchor piles will be drilled and grouted piles, and the temporary piles with be installed with a vibratory hammer. The grout used will be calculated for each pile based on drilling volumes. Because of the depth of water, there are no turbidity control devices that can be deployed. It is probable that minor sediment plumes will be created from turning augers and using vibratory hammers. The activities will be monitored by an ROV including the grouting of the piles to ensure that the piles are not overfilled.

3.6.2 Water Quality Monitoring

Limetree intends to monitor water quality immediately around each individual work area during all in-water work construction. Water quality monitoring will consist of collecting water samples being taken 1 m below the surface and 1 m above the seafloor up to 30 m in depth. Samples will be analyzed for turbidity expressed as Nephelometric Turbidity Units (NTUs), dissolved oxygen, and pH with a YSI meter a minimum of twice daily during all in-water construction. A total of 4 samples will be taken radially around the area of ongoing work (see Figure 10 for typical sample configuration) and 2 control samples located to the east and to the west of the work area. These samples will be taken at the edge of the expected impact area (as summarized in Table 2 above), or 10 m from the activity or the turbidity barriers surrounding dewatering points from barges, whichever is closest. If turbidity plumes are observed, additional samples will be taken within the plume or any other problematic area. Monitors will watch throughout the day and will collect additional samples if they see potential turbidity impacts. Samples will be taken at least 4 hours apart, unless there are visible plumes present. Monitors, both on the vessel and underwater, will monitor and document levels of water quality and turbidity control andinform the contractors when they document levels not meeting the standards detailed below.

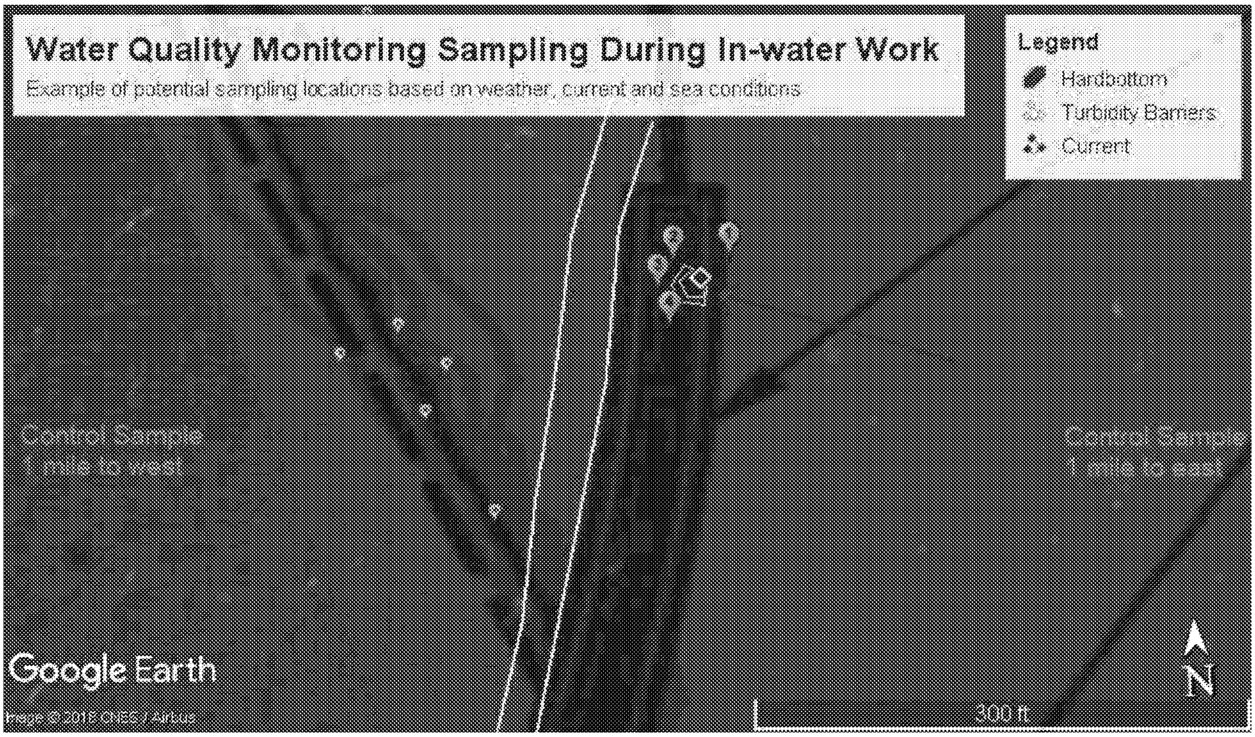

Figure 10. Typical Water Quality Monitoring During Construction

The 2 control samples, one to the east and one to the west of the project area, taken each time samples are taken at the project site, will be utilized to determine whether elevated turbidity is a function of the project or due to ambient conditions. As per the Water Quality Standards for Waters of the Virgin Islands Title 12, Chapter 7, Subchapter 186, depth visibility readings (Secchi disk measurements) should not be less than 1 m, and; NTU readings may not exceed three 3 NTUs absolute in class C waters. Wind speed and direction, wave height and direction, and rainfall will be recorded at the time of sampling.

If turbidity becomes elevated and exceeds 3 NTUs, trenching activities will cease until the issue is resolved and turbidity falls below 3 NTUs. In the event that background or ambient turbidity levels indicated by the control samples exceed 3 NTUs, activities will cease if samples around the construction area exceed the background levels. Activities will resume when turbidity is reduced to less ambient levels.

During construction, when the water samples show NTUs readings in excess of the allowable limits, the environmental monitor will notify by email the Department of Planning and Natural Resources (DPNR) and Limetree Bay Terminals. A Limetree representative must be present on-site at all times during construction and must have the authority to implement adaptive management of turbidity and sediment control devices, so that problems can be resolved between the environmental monitor, Limetree, and DPNR. If it is determined that the elevated turbidity is the result of the installation, the source of the problem will be identified, and methods developed to reduce suspended sediments in in order to continue construction. If turbidity cannot be controlled by implementing additional measures, the activity must slow down to limit introduction of fine sediments, and will have to stop every time turbidity exceeds 3 NTUs to allow turbidity to abate to 3 NTUs or less.

3.6.3 Environmental Monitoring

In order to assist minimize potential impacts and to help protect all coral resources (including ESA-listed species), monitoring divers will be on-site during the pipeline installation, including the trenching, drilling, grouting, anchoring and spudding, and placement of pipes. Divers will monitor, photograph, and video on-going activities, and assist in the location of the barge spuds to avoid impact to resources. Monitors will photograph and describe any noted impact to surrounding corals and immediately remediate any potential impacts to the greatest degree possible. Once activities move into water depths greater than 100 ft, an ROV will be used to monitor the activities and to document any potential impacts. Weekly reports will be provided to CZM, DPNR, USACE, Environmental Protection Agency (EPA), and NMFS.

Once the installation is complete, a final report will be prepared documenting the entire installation. The report will include a video of the installed components. The system installation will be monitored on a monthly basis for the first 6 months to assess any potential impacts and then on a semi-annual basis for the life of SPM.

In order to monitor the impact of the construction and operation of the project on the ESA-listed corals within the action area (see Section 4), 25 quadrats encompassing all of ESA-listed corals both on the dolos and on the critical habitat on the eastern side of the channel will the established. The ESA-listed corals on the channel wall slopes and those on the western side of the channel will not be monitored since these areas not likely to be impacted due to location. Quadrats of all ESA-listed coral species present in the action area will be established and photographed for 2 months prior to the start of construction as a baseline. These corals will then be monitored on a monthly basis during construction and for the first year following construction. Physical conditions such as percent live tissue, color, mucus production, discoloration, and bleaching will be recorded and compared to pre-construction conditions and used as a sign of health. Any changes in these physical conditions will trigger a shutdown of construction. Notifications will be made to the CZM, DPNR, USACE, EPA, and NMFS immediately upon discovery. Construction will remain shut down until the cause of the change in condition is discovered and resolved. Reports will be provided monthly throughout construction. After the first year, the quadrats will be monitored on a bi-annual basis for a period of 5 years to look at any long-term impact of the project on ESA species.

3.6.4 Post Installation Stabilization

Based on the data analysis provided in the geophysical survey report submitted by Limetree dated February 15, 2018, the excavation process will rely upon mechanical digging. Trenching and excavation using an excavator bucket will unconsolidate the hardbottom essential feature of coral critical habitat. This process is expected to create materials consisting of a mixture of sizes ranging from boulders, to rubble, sand, and fine silts. According to USACE (2017), one of the benefits of mechanical dredging is that marine excavators have accurate positioning ability controlling the location of the excavator, and are able to excavate firm or consolidated materials. Should excavation activities result in sedimentation outside of the direct footprint of the pipeline activities described above and summarized in Table 2, the following paragraph describes what Limetree will do to immediately rectify sedimentation on hardbottom outside of the pipeline footprint direct impact area.

During the trenching, divers will identify any large loose rocks or piles of material that have fallen outside the trench and have the trenching contractor remove them. Once the installation operations have moved out of an area, divers will collect smaller rocks and cobbles, place them in collection baskets and dispose of them in an upland area. As the divers move along, if fine sediments have collected on the hardbottom, divers will use small plastic bristle brushes and slowly scrap the material into a pile. It then can either be collected by hand or swept in to a bag, which can be sealed, placed in a basket and lifted to the surface. The bags will be placed in a basket for removal to the surface to prevent bags breaking or opening and spilling the fines. Once the area is clean, a video will be made and submitted of the condition of restored hardbottom.

3.7 Coral Relocation, Compensatory Mitigation, and Enhancement

Based on the expected impacts of the proposed project, Limetree has proposed to avoid impacts to corals through relocation, conduct compensatory mitigation for mountainous star coral encountered during pipeline installation, and to compensate for the loss of elkhorn and staghorn coral critical habitat. Limetree has also proposed to conduct additional coral collection and transplantation as a beneficial measure. These activities are described below.

3.7.1 Coral Relocation

Based on the benthic survey analyses described above in Section 3.4, the selected project footprint avoids all ESA-listed corals. However, other surveys conducted by Limetree determined that the abundance of mountainous star coral within the action area (outside of the pipeline footprint) was 0.000199 mountainous star coral per ft^2 (see Section 3.4), therefore it is possible that mountainous star coral may occur in the potential impact area that were not identified during the initial project surveys. Therefore, to be conservative, we estimated that up to 8 mountainous star coral (40,320 ft^2 of coral critical habitat to be impacted within the pipeline corridor [see Table 2] impacted x 0.000199 mountainous star coral per ft^2) could occur in the project footprint. If a mountainous star coral is encountered, Limetree will relocate it out of the impact footprint and transport it to the The Nature Conservancy (TNC) nursery at Cane Bay, St. Croix, USVI.

3.7.2 Compensatory Mitigation for Loss of Elkhorn and Staghorn Coral Critical Habitat

Despite being routed to avoid corals, the pipeline alignment still crosses over coral critical habitat. The quantity of impact to critical habitat is presented in Table 2. The total project impact, including all sections of the pipeline, to critical habitat is 0.9256 ac. Limetree has proposed a compensatory mitigation plan (submitted October 2018), titled "Minimization and Compensatory Mitigation Plan for Impacts to ESA Listed Species, Essential Fish Habitat, and Critical Habitat for Limetree Bay Terminal's Single Point Mooring Installation".

As is described in more detail in Section 5.3, the purpose of elkorn and staghorn critical habitat is to provide habitat to increase successful reproduction and recruitment of these two corals. A Resource Equivalency Analysis (REA) can be used to calculate the amount of compensatory mitigation needed to offset losses of coral colonies, or loss of critical habitat that would ultimately result in reduced coral recruitment. NOAA Fisheries has developed an REA calculator that is used to calculate the losses from injury and gains from outplanting nursery-propagated corals for compensatory mitigation. The REA takes into account species growth rate, life history, and number and size of colonies to calculate the number of colonies needed to offset losses. The REA analysis calculates the number of coral required to offset loss of either ESA-listed corals or coral critical habitat. The REA uses the Acropora Recovery Pan (ARP) (NMFS 2015) Criteria 1 as a basis for determining successful recovery, which indicates that a recovered elkhorn population requires achieving a density of 0.25 colonies ($\geq$ 1 m diameter in size) per m^2, throughout approximately 10% of consolidated reef habitat in 5-20 m water depth throughout the species' range. Similarly, a recovered population of staghorn coral requires achieving a density of one colony ($\geq$ 0.5 m diameter in size) per square meter (m^2), throughout approximately 5% of consolidated reef habitat in 5-20 m water depth throughout the species' range.

NMFS performed a REA for the project to determine on the number of elkhorn and staghorn coral to be the impacted by the loss of 0.9256 ac of coral critical habitat. NMFS identified the number of elkhorn and staghorn adult colonies this area of critical habitat could support (derived from the abundance criterion in the ARP (NMFS 2015). The NMFS REA used the published growth rate for the species (approximately 10 cm per year for both species), an outplanted colony size of at least 20 cm in size and a calculated recovery time (4 years). The proposed compensatory mitigation amounts (calculated by the REA) also account for 15% coral mortality that occurs due to outplanting stress (Schopmeyer et al. 2017). Based on these factors, the REA calculated that the permanent loss of 0.9256 ac of coral critical habitat would prevent 1,405 elkhorn colonies and 1,545 staghorn colonies from recruiting and growing on the lost critical habitat.

Limetree proposes to collect live ESA-listed coral fragments that were broken through natural processes (corals of opportunity) and provide them to TNC to fragment and propagate for outplanting. Limetree's consultant has observed live fragments of elkhorn and staghorn coral sitting on the sea bed in multiple locations around the St. Croix coastline (personal communication from A. Dempsey to M. Alvarez October 2018). These coral fragments are currently unattached due to natural causes (e.g., storms, hurricanes, wave swells). Limetree will collect up to 1,405 elkhorn and up to 1,545 staghorn corals of opportunity that will be stabilized and propagated in the for TNC coral nursery. Limetree will ultimately outplant 1,405 elkhorn and 1,545 staghorn colonies to compensate for the permanent loss of 0.9256 ac elkhorn and staghorn critical habitat (see Table 2).

Coral fragments and loose corals will be collected by divers from in the entire St. Croix coastline, placed in water filled bins and transported to the TNC facilities at Cane Bay or other TNC coral nurseries in St. Croix as established, including the Raceways, which are currently in development. All fragments collected will be inventoried, noting location of collection and the TNC coral nursery they are placed. This inventory will be included in the monthly monitoring report. Should Limetree be unable to collect sufficient fragments around St. Croix, Limetree will notify NMFS and recommend other locations within USVI for collection. TNC will stabilize and propagate corals for outplanting. Regular maintenance is performed on nursery structures and the corals themselves to ensure all are free of coral competitors and predators. Once coral fragments have grown to a size where the probability of survival (20 cm or greater when outplanted) on natural reefs has increased to an acceptable level (this usually requires 12 to 18 months depending on the initial size (Lirman 2000), the corals will be outplanted to 2 coral mitigation enhancement sites described in Section 3.7.4 below. Once the SPM construction is complete and TNC deems the corals are ready to be outplanted to the enhancement sites, the corals and coral fragments will then be attached using the methods outlined in the submitted compensatory mitigation plan submitted November 2018 titled "Minimization and Compensatory Mitigation Plan For Impacts To ESA Listed Species, Essential Fish Habitat and Critical Habitat".

3.7.3 Coral Collection and Outplanting

Limetree intends to collect up to 500 additional coral fragments of some combination of elkhorn, staghorn, mountainous star, lobed, star, boulder star, rough cactus, and pillar coral. All ESA-listed corals will be collected if fragments are found and provided to TNC. Half of those corals (250) will be used to help restock TNC's nursery at Cane Bay, which has suffered coral loss due to the recent hurricane events.

In addition to the 1,405 elkhorn and 1,545 staghorn coral fragments to be outplanted as compensation for loss of coral critical habitat (see Section 3.7.2) previously discussed, Limetree will also outplant 250 of the additionally collected corals of opportunity (of all ESA species from the same area listed in Section 3.7.2) and outplant these to the coral mitigation enhancement sites described in Section 3.7.4 below. If the collected corals lend themselves to fragmentation, TNC will be fragment the corals to increase the number of corals to be out planted at the enhancement site. Limetree estimates that at least 500 corals of opportunity are available within Christiansted Harbor near Round Reef, along the barrier reef and near the linear reef off Teague Bay on the north shore of St. Croix. Numerous corals have been seen broken and loose in dives over the last 6 months in St. Croix (personal communication with A. Dempsey and M. Alvarez, September 2018).

Table 3 provides a summary of the total ESA-listed corals that may be affected by the project.

Table 3. Number of ESA-listed corals that may be effected by the project

	Elkhorn coral	Staghorn coral	Mountainous star coral	All ESA Corals
Number relocated from impact area			8	
Number coral fragments collected for compensation	1,405	1,545		
Number outplanted for project compensation	1,405	1,545		
Number of coral fragments collected for restoration				500
Number outplanted for beneficial use				250

3.7.4 Coral Mitigation, Enhancement and Mitigation Monitoring

Limetree proposes to conduct coral outplanting at 2 coral mitigation enhancement sites (see Figure 11). One site will be located at St. Croix East End Marine Park (EEMP) at Great Pond (see Figure 12), which is approximately 6.25 mi to the east of the project site. The second site will be located at Long Reef, west of the Limetree channel and east of Ruth Island (Figure 13). These two coral mitigation enhancement sites have been chosen for the outplanting because they have are of a similar habitat type as the project site, and are relatively close to the project site. The corals that occur at these mitigation enhancement sites appear to have less sediment induced stress than those on other sites closer to the project area (personal communication A. Dempsey to M. Alvarez September, 2018).

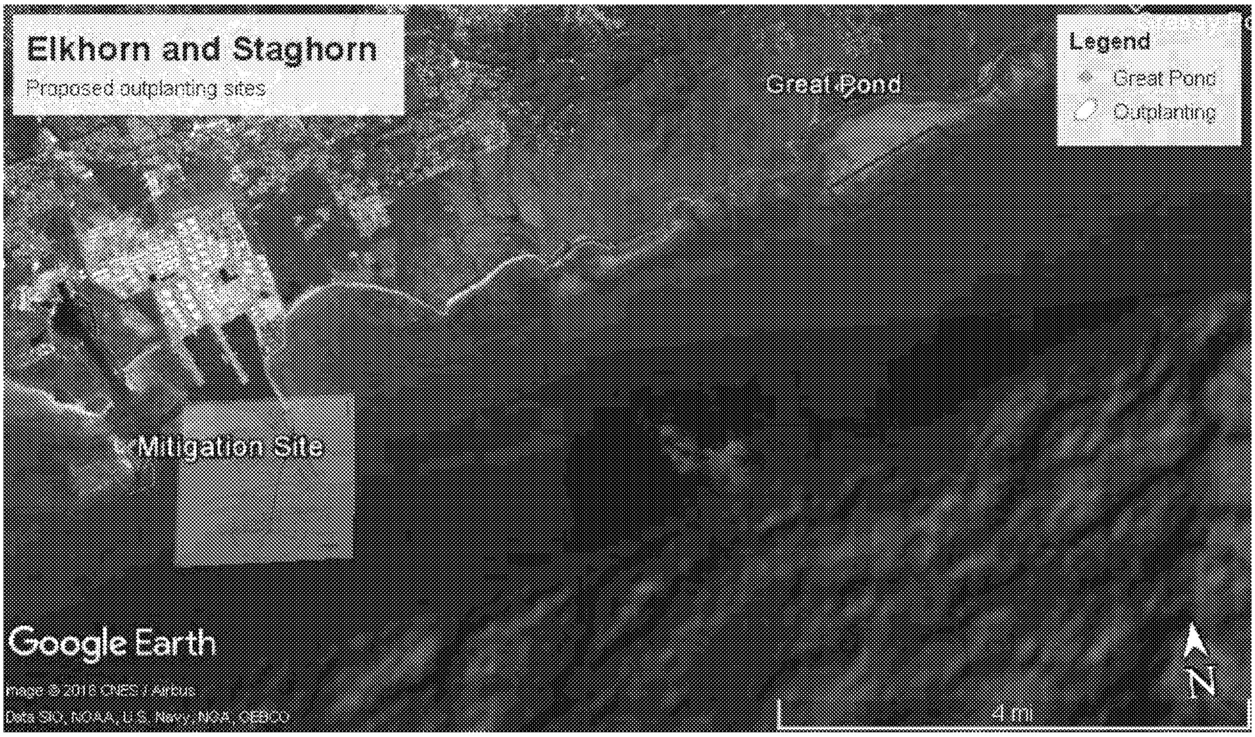

Figure 11 Proposed Outplanting Location Overview

Figure 12. Proposed Restoration Location

A coral colony that is ready to be outplanted to the coral mitigation enhancement sites will be adhered to a small rock using an adhesive to form a hardbottom base for the colony. Adhesives will either be two-part underwater epoxy, which sets in a matter of minutes, or hydraulic cement. The rock and coral will be, placed in coral transport buckets and attached to the underside of a vessel for transport. Vessels transporting corals will operate at idle speed. Once on site, the tray will be lowered near the seafloor and divers will remove the corals from the tray. The rock with coral will then be adhered to the sea bed with either two-part underwater epoxy or hydraulic cement. The base of the rock will be carefully cleaned with a wire brush and the new substrate will be cleaned to remove algae and any other material, which might interfere with the adhesion of the epoxy or cement. The rock base will be carefully placed on the seabed and held until the epoxy or cement starts to set.

Monitoring the compensatory mitigation enhancement sites is necessary to determine if the project is meeting its performance standards and to determine if corrective measures are necessary to ensure that the compensatory mitigation project is accomplishing its objectives. As per the guidelines set forth in 40 CFR §230.96 (2018), monitoring the mitigation sites will be for a minimum period of 5 years for all corals. The monitoring duration (5 years) dictated by the mitigation guidance is appropriate for corals to determine if the success criterion are met and to detect any mortality that results from the actual transplantation. After 2 years, transplants are usually the same as the wild population and any mortality that occurs is likely due to "natural" processes. In addition, while in general corals grow slowly, elkhorn and staghorn grow relatively fast compared to other corals. Mitigation will be monitored to determine whether the sites achieve an 85% survivability rate as detailed below.

Twenty-five percent of corals encompassing the same species and size class already at the mitigation enhancement site will also be monitored as controls. These corals will be marked and surveyed at the conclusion of the transplant. All of the ESA-listed relocated corals will be monitored every month and any change or demised will be reported. All of the outplanted corals will be monitored for survival and pictures will be used to document their growth. The marked corals will be surveyed for health and photographed on a monthly basis for the first 12 months. Maintenance will also continue throughout this time to ensure that corals reattach to the new substrate. All photographs will include location and scale as well as the description of the health of the corals photographed. Corals will then be monitored every two months for the next 2 years and then every 6 months for the following 2 years.

The results of the mitigation monitoring will be delivered to the agencies including NMFS PRD, NMFS HCD, DPNR, CZM and USACE as soon as possible after monitoring period. If negative impacts are noted, the agencies will be notified by phone and by email within 24 hours. The agencies and NMFS will be apprised of what steps are being taken to identify the impact and rectify the problem. The agencies, including NMFS, will be provided a detailed report on the steps that are taken and the results of those actions.

If the mitigation goal of 85 percent survival at the end of 5 years is not met, the applicant will prepare a detailed report of why the mitigation was not successful and will meet with the permitting agencies and establish additional compensatory mitigation to meet the mitigation goal.

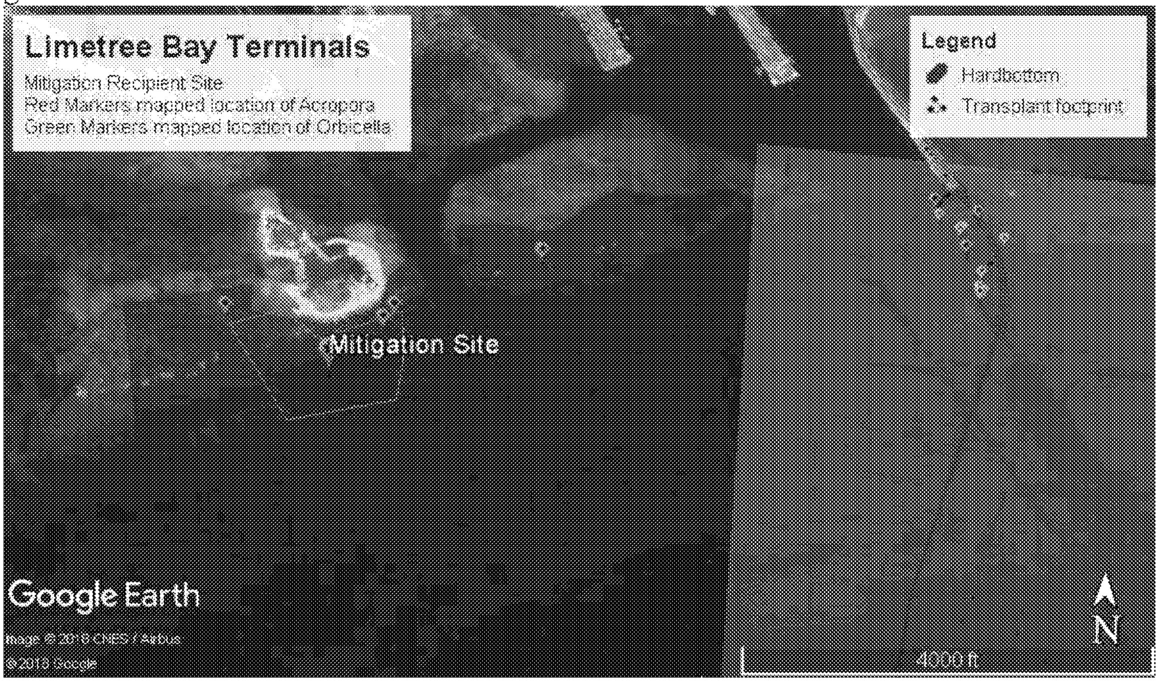

Figure 13. Mitigation Recipient Site

3.8 Conservation Measures

Based on information presented by the applicant, conservation measures that have been incorporated in the design of the SPM facilities intended to minimize potential impacts to ESA-listed species and their habitat include:

1. Reinforced silt fencing will be installed to contain the stockpiled excavated material at the end of the jetty. Runoff from the temporary stock will be directed back into the open trench.

2. NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* (dated March 23, 2006) will be implemented.

3. Compliance with NMFS *Vessel Strike Avoidance Measures and Reporting for Mariners*, revised on February 2008.

4. When ESA-listed species are observed in the work zone, additional information and corrective actions taken, such as a shutdown of trenching equipment, duration of the shut-down, behavior of the animal, and time spent in the safety zone will be recorded Reports will be provided to NMFS, USACE, and CZM on a monthly basis.

5. Sea turtle observers will be on-site daily to monitor the occurrence of sea turtles before, during, and after marine and shoreline construction activities. Observations will be made both above and below the water.

6. A biological monitoring program will be implemented to monitor the effects of project construction and operation on the adjacent aquatic ecosystem. A description of this program is in the submitted plan from November 2018 titled "Minimization and Compensatory Mitigation Plan For Impacts To ESA Listed Species, Essential Fish Habitat and Critical Habitat" and includes water quality monitoring for pH, turbidity, total suspended solids, dissolved oxygen, salinity, and temperature; monitoring of photo quadrats established to encompass nearby corals, including ESA-listed corals, which could be impacted by project impacted water quality; marine resource monitoring for sediment cover, benthic community, fish, and sea turtles. Monitoring will occur during all in-water work or work which has the potential of affecting water quality.

7. Construction on the jetties, relocation of dolos, and nearshore trenching will be done from land.

8. No spudding or anchoring of barges will occur outside the impact area identified in Table 2.

9. A double set of Type 3 turbidity barriers will be installed to intercept turbidity that may impact the ESA-listed coral colonizing dolos adjacent to the jetty. Turbidity barriers will be long enough to prevent turbidity from affecting corals and 1 ft. from seafloor. Monitoring divers will assist in the setting of curtains and curtain anchors to avoid impact to corals.

10. Prior to any construction activities, during the relocation of non-ESA listed coral species within the pipeline corridor, all ESA-listed corals encountered will be documented, relocated, and reported to NMFS.

11. A double set of turbidity barriers will be placed around the discharge points from the spoils barge, and a double set turbidity barriers will be placed to the northwest of the eastern channel slope trenching and the western channel slope dredging.

12. A caisson or cofferdam will be placed to help stabilize the pipeline trench off the end of the jetty, and minimize the erosion and resuspension of sediment, which could result from waves impacting the exposed jetty soils.

13. Material dredged in the channel will be side cast rather than brought to the surface to minimize turbidity impacts and by preventing the dredged material from dewatering and creating additional turbidity. Turbidity curtains will be used to direct suspended sediments into the channel bottom.

14. If sea conditions limit the functional efficiency of the turbidity curtain, operations will be suspended until conditions are suitable.

15. In-water work will not occur when seas or swells exceed 8ft within the project site.

16. During the coral spawning in the months of July, August, and September, there shall be no in water construction activities.

17. Water Quality and Environmental Monitoring shall be completed according to plans received November 2018 titled "Installation of a Single Point Mooring Water Quality and Environmental Monitoring". This should also include pre and post-construction surveys to ensure no direct impacts to aquatic resources outside the project footprint.

18. During operation of the SPM, any ballast water must be discharged through Limetree's ballast water treatment system.

19. NMFS shall receive and review all mitigation and monitoring reports within 60 days of the completion of the activity. All reports should clearly reference NMFS tracking number SER-2018-19292.

20. The contractor responsible for the mitigation must be experienced in large scale coral transplants with documented success rates exceeding the mitigation goal. The contractor and must be experienced in working with ESA-listed species. The contractor must have marine biologists on staff capable of coral identification and assessment of health to ensure proper identification and monitoring of health of species. The contractor must use divers experienced in coral transplants as well as working with lift bags and other similar equipment while on SCUBA.

21. Limetree will create an Endangered Species Management Plan to address the numerous ESA-listed species that occur in the Action Area, including listed corals, fish, marine mammals, sea turtles and birds. The plan will be provided to NMFS for review prior to the start of operations. The applicant will work with NMFS, FWS and DPNR during the drafting of this plan.

4 ACTION AREA

Pursuant to 50 C.F.R. § 402.02, the term *Action Area* is defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." Accordingly, the Action Area typically includes the affected jurisdictional waters and other areas affected by the authorized work or structures within a reasonable distance. The ESA regulations recognize that, in some circumstances, the Action Area may extend beyond the limits of the USACE's regulatory jurisdiction.

For the purposes of this consultation, the USACE has defined the Action Area to include approximately 3,750 ac of navigable waters, which could be subject to the potential direct and indirect impact of the proposed project. The boundaries of this Action Area are depicted in Figure 13 below. This area includes: the shoreline and navigation channel of the Limetree Bay Terminal Facility; the footprint and all work areas of the proposed project; and the adjacent navigable waters extending 1.0 mi to the northeast and 1.5 mi to the southwest of the proposed trenching work and pipeline footprint, as well as 0.25 mi to the southwest of the proposed SPM location. The Action Area encompasses the extent of Long Reef, particularly the waters around Ruth Island, which is located approximately 1.25 mi to the northwest of the proposed trenching work and pipeline footprint. In addition, the Action Area encompasses the western portion of Cane Bay (Figure 15). The action area includes the coral mitigation site at Great Pond as shown in Figure 11, and the VLBC pilot boarding area (Figure 16) 2-3 miles offshore the Limetree facility. The action area also includes all areas corals of opportunity are collected from (the coasts of St. Croix and other USVI territories if necessary) and the TNC nurseries.

The development of the entire St. Croix South Shore Industrial Complex in the 1960's has thoroughly altered the natural coastal and marine habitats of the area. The complex had been fully operational through 2012, then it sat vacant for 3 years and was then acquired by Limetree Bay Terminals, LLC in 2015. The extremely fine sediments, which have accumulated on the western side of the Limetree Bay Terminal channel and can be found covering the reef and the deeper slopes in this area, are in part the result of blasting and other extremely destructive methods, which were used to originally create the ports. West of the facility, the impacts can be seen for miles and water quality is impacted by the resuspension of the fine sediments which were created during the initial development of the ports, activities at a former the old aluminum factory, the St. Croix landfill, and the municipal sewer outfall. According to Limetree, releases into the marine environment have been documented in numerous incident reports from previous operators of the facility. Contaminants documented in marine and groundwater environments at the site include petroleum, methyl-tertiary-butyl ether, chromium, nickel, vanadium 2, lead, arsenic, and mercury (Holmes et al. 2012). More recently, under Limetree Bay Terminals, LLC control (starting in 2016), there have been five smaller (under 100 gallons) spills into surface waters that were reported to the U.S. Coast Guard (USCG), of varying products ranging from less than 2 gallons up to 84 gallons. Appropriate clean-ups and reporting were completed in all instances.

Further, to the west and outside of the Action Area is Sandy Point National Wildlife Refuge and critical habitat for leatherback sea turtles. Sea turtle nesting beaches are also found to the east of the proposed project area. Shallow reef systems, which support corals, are sporadically found through the southern coast of St. Croix. These areas are sporadically colonized by ESA-listed coral species, including elkhorn and mountainous star corals. The ESA-listed Nassau grouper also occurs in the action area and throughout the entire south shore of St. Croix. There are also dense seagrass beds located in shallow embayments along the south shore of St. Croix.

Figure 14. Action Area with Noise Effect Radii Analysis

Figure 15. Action area with Key Areas

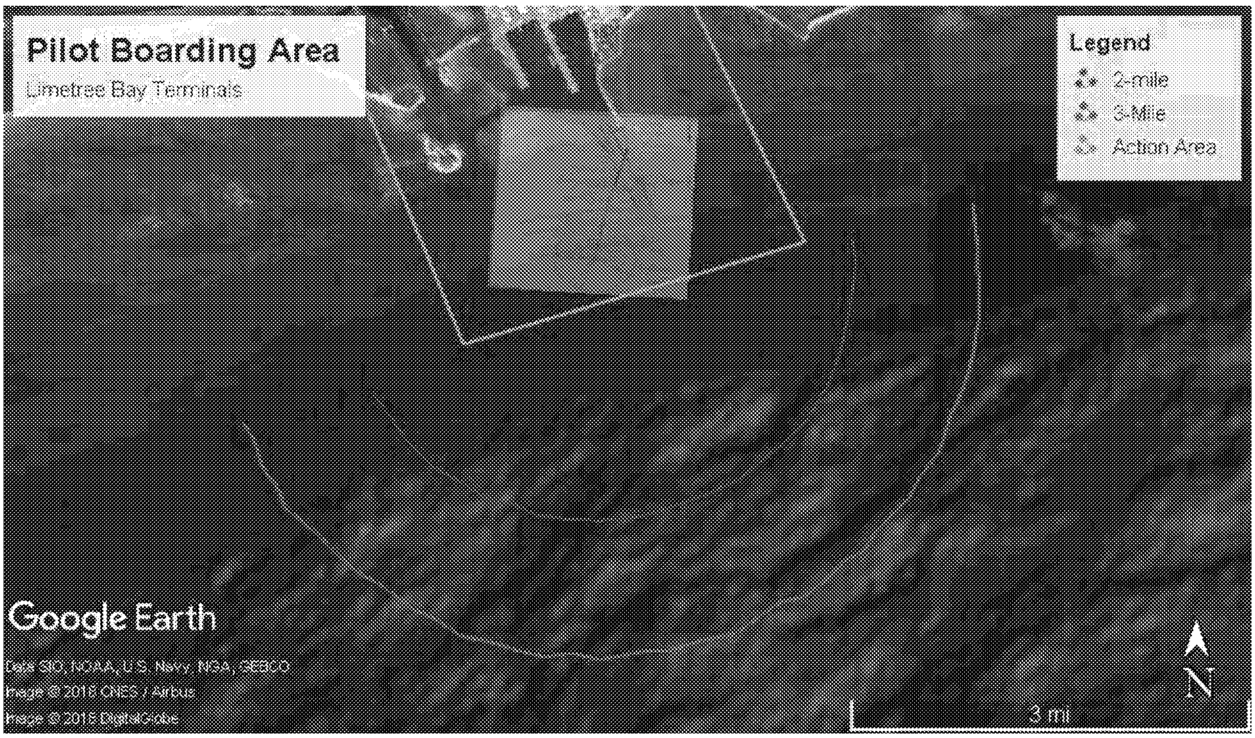

Figure 16. Pilot Boarding Areas

5 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

Table 3 lists the endangered (E) and threatened (T) whales, sea turtles, fish and coral species under the jurisdiction of NMFS that occur in or near the action area. Table 2 lists the designated critical habitat that occurs in or near the action area.

Table 4 Effects Determinations for Species the Action Agency or NMFS Believe May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Marine Mammals			
Blue whale	E	NLAA	NLAA
Fin whale	E	NLAA	NLAA
Sei whale	E	NLAA	NLAA
Sperm whale	E	NLAA	NLAA
Sea Turtles			
Green sea turtle North Atlantic Distinct Population Segment (DPS)	T	NLAA	NLAA
Green sea turtle South Atlantic DPS[1]	T	NLAA	NLAA
Loggerhead sea turtle Northwest Atlantic DPS	T	NLAA	NLAA
Hawksbill sea turtle	E	NLAA	NLAA
Leatherback sea turtle	E	NLAA	NLAA
Fish			
Nassau grouper	T	NLAA	NLAA
Scalloped hammerhead shark (Central Atlantic and Southwest Atlantic DPS)[2]	T	NLAA	NLAA
Oceanic whitetip shark	T	NLAA	NLAA
Giant manta ray	T	NLAA	NLAA
Invertebrates			
Elkhorn coral	T	NLAA	LAA

[1] Green sea turtles nesting in Puerto Rico are now within the North Atlantic DPS and green sea turtles nesting in the Virgin Islands are now within the South Atlantic DPS based on the final listing rule designating 11 DPSs published on April 6, 2016. However, because of the mobility of sea turtles, we consider both DPSs in this Opinion, as it is not possible to separate animals observed in the action area into one or the other of the DPSs given the small geographic separation between Puerto Rico and the Virgin Islands.

[2] The Central and Southwest Atlantic DPS and the Indo-West Pacific DPS of scalloped hammerhead shark were listed as threatened and the Eastern Atlantic DPS and Eastern Pacific DPS were listed as endangered on July 3, 2014 (79 FR 38214).

Staghorn coral	T	NE	LAA
Pillar coral	T	NE	LAA
Lobed star coral	T	NE	LAA
Mountainous star coral	T	LAA	LAA
Boulder star coral	T	NE	LAA
Rough cactus coral	T	NE	LAA
E = endangered, T = threatened, NLAA = may affect, not likely to adversely affect, LAA = may affect, likely to adversely affect, NE = no effect			

Table 5 Designated Critical Habitat in the Action Area

Species	Critical Habitat Unit	Action Agency Effect Determination	NMFS Effect Determination
Elkhorn and staghorn coral	St. Croix unit	LAA	LAA
LAA = may affect, likely to adversely affect			

5.1 Analysis of Species Not Likely to be Adversely Affected

5.1.1 Whales

There are 4 species of ESA-listed whales (blue, fin, sei, and sperm) that may be found in or near the action area. These species could be affected by the construction and operation of the Limetree Bay project by vessels transiting to and from the project either during construction of the pipeline or operations as part of the use of the SPM. Sighting and stranding data for USVI are limited. However, information from previous consultations, such as the marine events programmatic consultation with the USCG (SER-2014-13340), which included annually occurring events throughout USVI, indicated that whales have not been sighted during events.

There is no survey data for ESA-listed whale species in this area of USVI. Last year, there was a stranding of a baby sperm whale on Vieques Island, Puerto Rico, which is part of the Spanish Virgin Islands and not far from St. Thomas. Blue, fin, and sei whales may also be present in the Action Area during winter migration. ESA-listed whale species could be struck by work vessels transiting to and from the SPM location during its installation, in particular if work takes place during winter migration. The USACE will require compliance with NMFS *Vessel Strike Avoidance Measures and Reporting for Mariners*, revised on February 2008. The SPM and pipeline system will be installed using work vessels operating at slow speeds. All of these vessels will have sea turtle and marine mammal observers. This will provide protection to ESA-listed whales during the transit of work vessels by requiring vessels maintain set distances from whales for their transit. In addition to the required implementation of NMFS's vessel strike guidance, Limetree Bay Terminal and their contractor will implement a sea turtle and marine mammal monitor or observer training program for vessel crew members and construction personnel. Because whales are not likely to be present in the Action Area year-round, and given the survey programs and permit conditions the Corps USACE will require, we believe the risk of injury from collision with work vessels during the installation of the proposed SPM and pipeline system will be discountable.

ESA-listed whales could also be struck by the VLBCs. There is no information documenting that any vessel-whale collisions associated with the operations of bulk fuel storage and transfer facilities such as the Limetree Bay Terminal. Notwithstanding, USACE will require compliance with NMFS *Vessel Strike Avoidance Measures and Reporting for Mariners*, revised on February 2008 as part of all vessel operations. As noted above, Limetree will also implement additional monitoring and survey plans to determine the presence of ESA-listed whales and ensure vessel speed and operation are minimal to reduce the likelihood of any potential for impacts to these animals. Further, there are no impediments to whale movements in the deep waters where the SPM system will be located and along the transit routes for the fuel carrier vessels offshore where whales may be present during their winter migration. Based on all of this, as well as the lack of documented collisions, we expect that the risk of collisions between whales and fuel carrier vessels to be extremely unlikely, and therefore discountable. USACE and NOAA will receive regular reports with the results of the sea turtle and marine mammal survey from Limetree in order to verify both the presence of ESA-listed whales and that vessel interactions are not impacting them.

Mooring chains could pose an entanglement risk for ESA-listed whales. However, we expect that the thickness of the chain will prevent tackle from becoming slack enough to form loops that could lead to entanglement. The two greatest threats to whales are ship strikes and entanglement with commercial fishing gear. Entanglement in the mooring tackle is unlikely because both ends of the mooring chain would be fixed with only enough slack to allow the SPM and marker buoys to move with waves and currents. In addition, the regular maintenance and monitoring of the mooring tackle will assure the integrity of the mooring chains. Therefore, we believe the risk of entanglement in mooring chains is discountable.

Whales could be adversely impacted by potential spills of fuels during the operation of the proposed project. The operation of the terminal currently involves the transfer of fuel from/to carrier vessels. As part of its present operations, Limetree has in place an Integrated Contingency Plan, dated July 2017, which addresses in detail the facility's plans and actions to prevent and respond to a potential spill of petroleum products during regular and emergency situations, such as hurricanes, and minimize any potential environmental impacts. Fuel transfers are continuously monitored and Limetree has responders on-site at all times. Limetree has conducted modeling (Transas Full Mission Simulator) and the design has been certified by the American Bureau of Shipping to ensure that the SPM is designed appropriately, such that spills are unlikely to occur. The modeling accounts for local hydrodynamics (full range of sea states, waves and currents) and the proposed operations (for example, the mooring lines used for the vessel). Based on this modeling information, NMFS has determined that this specific configuration of the SPM will make it extremely unlikely that a large-scale, acute fuel spill would be severe enough to produce adverse effects to whales. Therefore, we believe that the potential for adverse effects to whales from potential fuel spills during the operation of the proposed project will be discountable.

Noise generated during the proposed installation of anchor pilings has the potential to physically injure or change the behavior of ESA listed whales, which could be present in the vicinity of the project area. Injurious effects to these species can occur in two ways. First, immediate adverse effects can occur to listed species if a single noise event exceeds the threshold for direct physical injury. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for the animals, and these can constitute adverse effects, if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse if such effects prevent animals from migrating, feeding, resting, or reproducing, for example.

Our analysis considered the specific details of the proposed temporary, 18-in steel piles utilized for assisting with the laying of the pipeline activities, as summarized above in the Project Description. Accordingly, for the purposes of the noise effects analysis the project location is considered open waters. No additional noise abatement measures or adjustments were included in the noise analysis and a vibratory hammer will install the piles.

According to our results, the installation of the steel temporary piles by vibratory hammer would not cause single-strike or peak-pressure injury to ESA-listed whales. The cumulative sound exposure level (cSEL) of multiple pile strikes over the course of a day may cause injury to ESA listed whales at a radius of up to 10.6 m for low-frequency marine mammals (blue, fin and sei whales) and 1.7 m for mid-frequency marine mammals (sperm whales). To minimize potential impacts to federally protected whale species, the applicant is proposing and the USACE would require establishing a 500-m safety/monitoring zone around the project area during project construction. Trained observers would visually monitor the safety zone for at least 30 minutes prior to beginning all in-water construction activities, and throughout the pile driving operation. If at any time, a whale were observed in this safety zone the operation would be shut down until the animal leaves the safety zone of its own volition. This will effectively protect whales from potential noise impact related injury if they were to approach the pile installation area. In addition, due to the mobility of whales, we expect them to move away from noise disturbances. Because we anticipate the animal will move away, we believe that the possibility of a whale suffering physical injury from noise will be extremely unlikely to occur and the likelihood of any injurious cSEL effects will be discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

Due to the mobility of whales, we expect them to move away from noise disturbances. Since there is similar habitat in adjacent waters, therefore we believe behavioral effects would be insignificant. If a whale chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. Since pile installation activities would be completed in less than ten days and whales will be able to resume normal activities during quiet periods between pile installations and immediately after completion of the noise producing activities. Therefore, we anticipate that any project related behavioral effects to ESA listed whales will be insignificant.

5.1.2 Sea Turtles

Effects to green, leatherback, loggerhead and hawksbill sea turtles include the potential risk of injury from being struck by in-water construction machinery (barges, cranes, excavators, spuds, anchors, etc.) during the proposed construction work. Green, loggerhead and hawksbill sea turtles were observed in the Action Area during benthic surveys conducted for the project. The Action Area (Figure 14) is located along the southern shore of St. Croix, so access to open water is not impeded in any way for sea turtles that may be in the area during operation of in-water construction machinery. The trenching and pile-driving barge will be anchor or spud in place while conducting in-water work. The pipeline laying barge will not set anchor or spuds, but would be moving at very low speeds. As a result, sea turtles will be able to hear and see in water construction machinery. We expect any animals that approach the in-water work areas to swim away. The applicant will operate in compliance with NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006. The implementation of the construction conditions will provide protection to sea turtles by requiring temporary work stoppages to protect any sea turtles that approach the in-water work area. Limetree Bay Terminal's contractor will also implement a sea turtle and marine mammal monitoring program during the proposed work, which will include training of personnel involved in in-water work as observers. Therefore, the NMFS believes the risk of injury from in-water construction machinery will be discountable.

Sea turtles could be struck also by work vessels transiting to and from the proposed work areas. The USACE would require compliance with NMFS *Vessel Strike Avoidance Measures and Reporting for Mariners*, revised on February 2008. The offshore SPM and pipeline will be installed using work vessels operating at slow speeds and have sea turtle and marine mammal observers on board. This will provide protection to sea turtles during the transit of work vessels by requiring that vessels maintain set distances from sea turtles. In addition to the required implementation of NMFS's vessel strike guidance, Limetree Bay Terminal's contractor would implement a sea turtle observer and monitoring program for the proposed work vessels crew members and construction personnel. Records will be maintained of all sea turtle sightings in the area, including date and time, weather conditions, species identification, approximate distance from the project area, direction and heading in relation to the project area, and behavioral observations. When animals are observed in the safety zone (as described in Section 5.1.1), additional information and corrective actions taken such as a shutdown of trenching equipment Based on this information, the risk of sea turtle injury from collision with work vessels during transit of work vessels and use of work vessels to install the offshore mooring will be discountable.

In addition, sea turtles could be struck by the VLBCs during the operation of the project. The normal current operations of the Limetree Bay Terminal already include regular transit of fuel carrier ships. The proposed SPM will be installed just offshore of active port areas with defined navigation channels used by numerous commercial vessels. The installation of the SPM will reduce the number of vessels transiting into the Limetree Bay Terminal by up to 50 ships per year, thus reducing the opportunities for turtles to be struck by fuel carriers. Fuel cargo vessels approaching the proposed SPM would move at very slow speeds (5 knots when the pilot boards 3 miles from the SPM, slowing to a half knot for the last 1000 ft). Turtles were found to flee approximately 60% of the time from slow moving vessels (2.17 knots) (Hazel et al. 2007). According to NMFS 2015, unpublished sea turtle stranding data from the U.S. Virgin Islands Department of Planning and Natural Resources indicate that from 1982 to 2006 there were 22 strandings with only four caused by boats in St. Thomas. In St. Croix, there were 74 strandings with only five caused by boats. All of the reported strandings took place in nearshore areas.

Nearshore areas provide forge and refuge habitat, especially for loggerhead and hawksbill turtles, which makes it more likely that these species will be found in there. The transit routes to/from the proposed SPM would be located in deep water, unlike the current transiting of ships in shallow water. By operating the SPM, 50 less ships per year will transit the shallow water, thus reducing the risk of sea turtle strikes. Given the deep water location of the SPM, the slow speeds of these vessels, and lack of impediments to sea turtles swimming away from the vessels in those deep waters, we expect that the risk of collisions will be extremely unlikely. Therefore, the risk of collisions to sea turtles from the fuel cargo vessels transits will be discountable.

Loggerhead and hawksbill sea turtles could also be impacted by the temporary or permanent loss of use of potential foraging or refuge habitat associated with the installation of the proposed SPM and pipeline. There are areas of colonized hard bottom in the immediate vicinity of SPM and pipeline. Colonized hard bottom will be directly impacted during the proposed trenching, installation of the pipeline, and pile driving. Those activities could result in temporary impacts to loggerhead and hawksbill sea turtles foraging and refuge habitats from sediment transport and permanent loss of habitat in the footprint of the pipeline. However, the impacts from sediment transport are expected to be minimal because turbidity barriers and an open water caisson would be used during work at the end of the jetty and a water quality and environmental monitoring plan requiring work stoppages if turbidity levels higher than normal are detected will be implemented for the material excavated during the proposed trenching work. Similarly, considering that extensive colonized hard bottom areas that are present throughout and surrounding the Action Area (see Figure 14), and that the existing revetment on the Limetree Bay Terminal jetties are heavily colonized by corals, sponges, and other sessile benthic organisms, we believe the installation of the proposed SPM and pipeline will have minimal impacts on sea turtle refuge and foraging habitat. Based on this information, the temporary or permanent loss of use of potential foraging or refuge habitat associated with the installation of the proposed SPM and pipeline are expected to have insignificant effects on loggerhead and hawksbill sea turtles.

As stated in the project description, the SPM and under water hoses will be secured to the marine floor using chains and anchor piles. Similarly, the marker buoys will be anchored using chains and concrete blocks. The mooring chains could pose an entanglement risk for sea turtles if the line becomes slack or is capable of forming loops. However, we expect that the thickness of the chain would prevent tackle from becoming slack enough to form loops that could lead to entanglement. In addition, the mooring chains would be given only enough slack to enable the SPM and marker buoys to move up and down with the wind and waves and are not expected to form loops. Based on this information, we believe the threat of entanglement of sea turtles in the mooring tackle is discountable.

Sea turtles could be adversely impacted by potential spills of fuels during the operation of the proposed project. The operation of the terminal currently involves the transfer of fuel from/to carrier vessels. As part of its present operations, Limetree has in place an Integrated Contingency Plan, dated July 2017, which addresses in detail the facility's plans and actions to prevent and respond to a potential spill of petroleum products during regular and emergency situations, such as hurricanes, and minimize any potential environmental impacts. Fuel transfers are continuously monitored and Limetree has responders on-site at all times. Limetree has conducted modeling (Transas Full Mission Simulator) and the design has been certified by the American Bureau of Shipping to ensure that the SPM is designed appropriately, such that spills are unlikely to occur. The modeling accounts for local hydrodynamics (full range of sea states, waves and currents) and the proposed operations (for example, the mooring lines used for the vessel). Based on this modeling information, NMFS has determined that this specific configuration of the SPM will make it extremely unlikely that a large-scale, acute fuel spill would be severe enough to produce adverse effects to sea turtles. Therefore, we believe that the potential for adverse effects to sea turtles from potential fuel spills during the operation of the proposed project will be discountable.

Leatherback sea turtles are known to nest on a beach close to the Action Area and could be effected by the continuous work and ship operations during the 10 days of pipeline installation. The water based operation will be lighted during evening hours and could have the potential to change the behavior of leatherback sea turtles headed to the nearby beach. The leatherback turtles could get confused from the lighting and not reach their destination for nesting. However, the project will not be built during nesting months and will only take a short period of time to construct (10 days). Therefore, the potential for adverse effects to leatherback sea turtle nesting behaviors from lighting of construction vessels will be discountable.

Noise generated during the proposed installation of temporary, steel pilings has the potential to physically injure or change the behavior of ESA-listed sea turtles, which could be present in the vicinity of the project area. Injurious effects to these species can occur in two ways. First, immediate adverse effects can occur to listed turtle if a single noise event exceeds the threshold for direct physical injury. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for the animals, and these can constitute adverse effects, if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse if such effects prevent animals from migrating, feeding, resting, or reproducing, for example.

The noise or acoustic effects analysis considered the specific details of the proposed temporary, steel pile driving activities, as summarized above in the Project Description. Accordingly, for the purposes of the noise effects analysis the project location is considered open waters. No additional noise abatement measures or adjustments were included in the noise analysis.

Based on our noise calculations, the installation of the 18-in steel piles by vibratory hammer will not cause single-strike or peak-pressure injury to ESA-listed sea turtles. However, the cSEL of multiple pile strikes over the course of a day may cause injury to sea turtles at a radius of up to 0.2 m (0.6 ft). To minimize potential impacts to ESA-listed sea turtles, the applicant is proposing and the USACE will require establishing a 500-m safety/monitoring zone around the project area during project construction (see Conservation Measures 2 and 3). Trained observers will visually monitor the safety zone for at least 30 minutes prior to beginning, and throughout all in-water construction activities. If at any time, a sea turtle is observed in this safety zone, which is well before the sea turtles threshold for injurious effects, the operation will be shut down until the animal leaves the safety zone of its own volition. This will effectively protect sea turtles from potential noise impact related injury if they were to approach the pile installation area. In addition, due to the mobility of sea turtles, we expect them to move away from noise disturbances. Because we anticipate the animal will move away, we believe that the possibility of a sea turtle suffering physical injury from noise will be extremely unlikely. Therefore, the likelihood of any injurious cSEL effects to sea turtles will be discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

Based on our noise calculations, vibratory hammer pile installation could also cause behavioral effects at radii of 100 m (328 ft) for sea turtles. Due to the mobility of sea turtles, we expect them to move away from noise disturbances. Because there is similar habitat nearby, we believe behavioral effects will be insignificant. If a sea turtle chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. Since pipe installation activities will be completed in less than ten days, sea turtles will be able to resume normal activities during quiet periods between pile installations and immediately after completion of the noise producing activities. Therefore, we anticipate that any project related behavioral effects to sea turtles will be insignificant.

5.1.3 Fish (Nassau grouper, giant manta ray, oceanic whitetip shark and scalloped hammerhead shark)

Effects to Nassau grouper, giant manta ray, oceanic whitetip shark and scalloped hammerhead shark from this project include the potential risk of injury from being struck by in-water construction machinery and vessels (barges, anchors, spuds, dredge, crane, etc.) within the in-water work footprint and operation of the SPM. Sightings data indicate that only Nassau groupers have been observed within the proposed work areas. However, the colonized reef, hardbottom areas, macroalgae and seagrass areas, and escarpment within the Action Area could also provide suitable foraging habitats for the scalloped hammerhead shark. Giant manta ray has been noted outside the action area in deeper waters. Both giant manta ray and oceanic whitetip shark may find forage habitat in the deep waters of the SPM buoy. Notwithstanding, the proposed SPM and pipeline system will be installed using work vessels operating at slow speeds. Due to their mobility, we expect Nassau grouper, giant manta ray, oceanic whitetip shark and scalloped hammerhead shark individuals to move away from any operating in-water equipment. Based on the above, injury from in-water construction machinery is extremely unlikely to occur; therefore, this effect will be discountable.

Nassau grouper, giant manta ray, and scalloped hammerhead shark individuals could also be impacted by the temporary and permanent loss of use of hardbottom habitat as potential foraging or refuge habitat associated with the proposed SPM and pipeline. Colonized reef and hard bottom habitat will be permanently impacted during the proposed trenching, installation of the pipeline, and pile driving. Those activities could also result in temporary impacts to the above listed species foraging and refuge habitats within the Action Area from potential sediment transport and avoidance of the site due to construction activities and permanent loss of habitat in the footprint of the pipeline. However, these impacts are expected to be minimal because turbidity barriers and an open water caisson will be used during work at the end of the jetty and a water quality and environmental monitoring plan requiring work stoppages if turbidity levels higher than normal are detected will be implemented. The above described measures will ensure sediment resuspension during project construction does not impact adjoining and or distant coral, sponge, and other benthic resources. Similarly, considering the short duration (10 days) of the proposed in-water work activities and the fact that extensive colonized reef and escarpment, hardbottom areas, and macroalgae and seagrass dominated areas that are present throughout and surrounding the Action Area, we believe the installation of the proposed SPM and pipeline will have minimal impacts on Nassau grouper, giant manta ray, and scalloped hammerhead shark individuals ability to access the project area for refuge and foraging habitat. Based on this information, the temporary or permanent loss of use of potential foraging or refuge habitat associated with the installation of the proposed SPM and pipeline are expected to have insignificant effects on Nassau grouper, giant manta ray, and scalloped hammerhead shark.

As stated in the project description, the SPM and under water hoses will be secured to the marine floor using chains and anchor piles. Similarly, the marker buoys will be anchored using chains and concrete blocks. The mooring chains could pose an entanglement risk for Nassau grouper, giant manta ray, oceanic whitetip shark and scalloped hammerhead shark individuals if the line becomes slack or is capable of forming loops. However, we expect that the thickness of the chain will prevent tackle from becoming slack enough to form loops that could lead to entanglement. In addition, the mooring chains will be given only enough slack to enable the SPM and buoys to move up and down with the wind and waves and are not expected to form loops. Based on this information, as well as the proposed environmental monitoring and maintenance plans for the SPM system, we believe the threat of entanglement of Nassau grouper, giant manta ray, oceanic whitetip shark and scalloped hammerhead shark in the mooring chains will be discountable.

Nassau grouper, giant manta ray, oceanic whitetip shark and scalloped hammerhead shark individuals could be adversely impacted by potential spills of fuels during the operation of the proposed project. The operation of the terminal currently involves the transfer of fuel from/to carrier vessels. As part of its present operations, Limetree Bay Terminals has in place an Integrated Contingency Plan, dated July 2017, which addresses in detail the facility's plans and actions to prevent and respond to a potential spill of petroleum products during regular and emergency situations, such as hurricanes, and minimize any potential environmental impacts. Fuel transfers are continuously monitored and Limetree has responders on-site at all times. Limetree has conducted modeling (Transas Full Mission Simulator) and the design has been certified by the American Bureau of Shipping to ensure that the SPM is designed appropriately, such that spills are unlikely to occur. The modeling accounts for local hydrodynamics (full range of sea states, waves and currents) and the proposed operations (for example, the mooring lines used for the vessel). Based on this modeling information, NMFS has determined that this specific configuration of the SPM, it is extremely unlikely that a large-scale, acute fuel spill will be severe enough to produce adverse effects to Nassau grouper, giant manta ray, oceanic whitetip shark and scalloped hammerhead shark. Therefore, the potential for adverse effects to Nassau grouper, giant manta ray, oceanic whitetip shark and scalloped hammerhead shark individuals from potential fuel spills during the operation of the proposed project will be discountable.

Noise generated during the proposed installation of temporary steel piles has the potential to physically injure or change the behavior of ESA-listed fish, which could be present in the vicinity of the project area. Injurious effects to these species can occur in two ways. First, immediate adverse effects can occur to listed species if a single noise event exceeds the threshold for direct physical injury. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for the animals, and these can constitute adverse effects, if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse if such effects prevent animals from migrating, feeding, resting, or reproducing, for example.

The noise or acoustic effects analysis considered the specific details of the proposed temporary, steel pile driving activities, as summarized above in the Project Description. Accordingly, for the purposes of the noise effects analysis, the project location is considered to be in open waters. No additional noise abatement measures or adjustments were included in the noise analysis.

Based on our noise calculations, the installation of the 18-in steel piles by vibratory hammer will not cause single-strike or peak-pressure injury to ESA-listed fish (Nassau grouper, giant manta ray, oceanic whitetip shark, and scalloped hammerhead sharks). The cSEL of multiple pile strikes over the course of a day may cause injury to those ESA listed fish species at a radius of up to 0.1892 m (0.621 ft) for fish greater than 102 grams and 26.738 m (87.722ft) for fish less than 102 grams. Due to the mobility of ESA-listed fish species, we expect them to move away from noise disturbances. Because we anticipate fish to move away, we believe that an animal suffering physical injury from noise will be extremely unlikely to occur and the likelihood of any injurious cSEL effects will be discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

Based on our noise calculations, vibratory hammer pile installation could also cause behavioral effects at radii of 100 m (328.084 ft) for ESA-listed fish. Due to the mobility of ESA-listed fish species, we expect them to move away from noise disturbances. Because there is similar habitat nearby, we believe behavioral effects will be insignificant. If a species chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. Since pipe installation activities will be completed in less than ten days, these species will be able to resume normal activities during quiet periods between pile installations and immediately after completion of the noise producing activities. Therefore, we anticipate any project related behavioral effects to ESA-listed fish species (Nassau grouper, giant manta ray, oceanic whitetip shark, and scalloped hammerhead sharks) will be insignificant.

For the reasons given above, NMFS has determined that the project may affect, but is not likely to adversely affect, ESA-listed sea turtles, ESA-listed fish, and marine mammals.

5.2 Status of Species and Critical Habitat Likely to be Adversely Affected

Mountainous star, lobed star, boulder star, rough cactus, pillar, elkhorn and staghorn corals and designated critical habitat for elkhorn and staghorn corals are likely to be adversely affected by the proposed action.

In the summaries that follow, the status of the ESA-listed species and their designated critical habitats that occur within the proposed action area and are considered in this Opinion, are described. More detailed information on the status and trends of these listed resources and their biology and ecology can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on these NMFS websites:

- http://sero.nmfs.noaa.gov/protected_resources/index.html
- http://www.nmfs.noaa.gov/pr/species/esa/index.htm

5.2.2 General Threats Faced by All Coral Species

Corals face numerous natural and man-made threats that shape their status and affect their ability to recover. Either many of the threats are the same or similar in nature for all listed coral species, those identified in this section are discussed in a general sense for all corals. All threats are expected to increase in severity in the future. More detailed information on the threats to listed corals is found in the Final Listing Rule (79 FR 53851; September 10, 2014). Threat information specific to a particular species is then discussed in the corresponding status sections where appropriate.

Several of the most important threats contributing to the extinction risk of corals are related to global climate change. The main concerns regarding impacts of global climate change on coral reefs generally, and on listed corals in particular, are the magnitude and the rapid pace of change in greenhouse gas (GHG) concentrations (e.g., carbon dioxide [CO_2] and methane) and atmospheric warming since the Industrial Revolution in the mid-19th century. These changes are increasing the warming of the global climate system and altering the carbonate chemistry of the ocean (ocean acidification). Ocean acidification affects a number of biological processes in corals, including secretion of their skeletons.

Ocean Warming

Ocean warming is one of the most important threats posing extinction risks to the listed coral species, but individual susceptibility varies among species. The primary observable coral response to ocean warming is bleaching of adult coral colonies, wherein corals expel their symbiotic algae in response to stress. For many corals, an episodic increase of only 1°C–2°C above the normal local seasonal maximum ocean temperature can induce bleaching. Corals can withstand mild to moderate bleaching; however, severe, repeated, and/or prolonged bleaching can lead to colony death. Coral bleaching patterns are complex, with several species exhibiting seasonal cycles in symbiotic algae density. Thermal stress has led to bleaching and mass mortality in many coral species during the past 25 years.

In addition to coral, bleaching, other effects of ocean warming can harm virtually every life-history stage in reef-building corals. Impaired fertilization, developmental abnormalities, mortality, impaired settlement success, and impaired calcification of early life phases have all been documented. Average seawater temperatures in reef-building coral habitat in the wider Caribbean have increased during the past few decades and are predicted to continue to rise between now and 2100. Further, the frequency of warm-season temperature extremes (warming events) in reef-building coral habitat has increased during the past 2 decades and is predicted to continue to increase between now and 2100.

Ocean Acidification

Ocean acidification is a result of global climate change caused by increased CO_2 in the atmosphere that results in greater releases of CO_2 that is then absorbed by seawater. Reef-building corals produce skeletons made of the aragonite form of calcium carbonate. Ocean acidification reduces aragonite concentrations in seawater, making it more difficult for corals to build their skeletons. Ocean acidification has the potential to cause substantial reduction in coral calcification and reef cementation. Further, ocean acidification impacts adult growth rates and fecundity, fertilization, pelagic planula settlement, polyp development, and juvenile growth. Ocean acidification can lead to increased colony breakage, fragmentation, and mortality. Based on observations in areas with naturally low pH, the effects of increasing ocean acidification may also include reductions in coral size, cover, diversity, and structural complexity.

As CO_2 concentrations increase in the atmosphere, more CO_2 is absorbed by the oceans, causing lower pH and reduced availability of calcium carbonate. Because of the increase in CO_2 and other GHGs in the atmosphere since the Industrial Revolution, ocean acidification has already occurred throughout the world's oceans, including in the Caribbean, and is predicted to increase considerably between now and 2100. Along with ocean warming and disease, we consider ocean acidification to be one of the most important threats posing extinction risks to coral species between now and the year 2100, although individual susceptibility varies among the listed corals.

Diseases

Disease adversely affects various coral life history events by, among other processes, causing adult mortality, reducing sexual and asexual reproductive success, and impairing colony growth. A diseased state results from a complex interplay of factors including the cause or agent (e.g., pathogen, environmental toxicant), the host, and the environment. All coral disease impacts are presumed to be attributable to infectious diseases or to poorly described genetic defects. Coral disease often produces acute tissue loss. Other forms of "disease" in the broader sense, such as temperature-caused bleaching, are discussed in other threat sections (e.g., ocean warming as a result of climate change).

Coral diseases are a common and significant threat affecting most or all coral species and regions to some degree, although the scientific understanding of individual disease causes in corals remains very poor. The incidence of coral disease appears to be expanding geographically, though the prevalence of disease is highly variable between sites and species. Increased prevalence and severity of diseases is correlated with increased water temperatures, which may correspond to increased virulence of pathogens, decreased resistance of hosts, or both. Moreover, the expanding coral disease threat may result from opportunistic pathogens that become damaging only in situations where the host integrity is compromised by physiological stress or immune suppression. Overall, there is mounting evidence that warming temperatures and coral bleaching responses are linked (albeit with mixed correlations) with increased coral disease prevalence and mortality.

Trophic Effects of Reef Fishing

Fishing, particularly overfishing, can have large-scale, long-term ecosystem-level effects that can change ecosystem structure from coral-dominated reefs to algal-dominated reefs ("phase shifts"). Even fishing pressure that does not rise to the level of overfishing potentially can alter trophic interactions that are important in structuring coral reef ecosystems. These trophic interactions include reducing population abundance of herbivorous fish species that control algal growth, limiting the size structure of fish populations, reducing species richness of herbivorous fish, and releasing coralivores from predator control.

In the Caribbean, parrotfishes can graze at rates of more than 150,000 bites per square meter per day (Carpenter 1986), and thereby remove up to 90-100% of the daily primary production of algae . With substantial populations of herbivorous fishes, as long as the cover of living coral is high and resistant to mortality from environmental changes, it is very unlikely that the algae will take over and dominate the substrate. However, if herbivorous fish populations, particularly large-bodied parrotfish, are heavily fished and a major mortality of coral colonies occurs, then algae can grow rapidly and prevent the recovery of the coral population. The ecosystem can then collapse into an alternative stable state, a persistent phase shift in which algae replace corals as the dominant reef species. Although algae can have negative effects on adult coral colonies (e.g., overgrowth, bleaching from toxic compounds), the ecosystem-level effects of algae are primarily from inhibited coral recruitment. Filamentous algae can prevent the colonization of the substrate by planula larvae by creating sediment traps that obstruct access to a hard substrate for attachment. Additionally, macroalgae can block successful colonization of the bottom by corals because the macroalgae takes up the available space and causes shading, abrasion, chemical poisoning, and infection with bacterial disease. Trophic effects of fishing are a medium importance threat to the extinction risk for listed corals.

Sedimentation

Human activities in coastal and inland watersheds introduce sediment into the ocean by a variety of mechanisms including river discharge, surface runoff, groundwater seeps, and atmospheric deposition. Humans also introduce sewage into coastal waters through direct discharge, treatment plants, and septic leakage. Elevated sediment levels are generated by poor land use practices and coastal and nearshore construction.

The most common direct effect of sedimentation is sediment landing on coral surfaces as it settles out from the water column. Corals with certain morphologies (e.g., mounding) can passively reject settling sediments. In addition, corals can actively remove sediment but at a significant energy cost. Corals with large calices (skeletal component that holds the polyp) tend to be better at actively rejecting sediment. Some coral species can tolerate complete burial for several days. Corals that cannot remove sediment will be smothered and die. Sediment can also cause sub lethal effects such as reductions in tissue thickness, polyp swelling, zooxanthellae loss, and excess mucus production. In addition, suspended sediment can reduce the amount of light in the water column, making less energy available for coral photosynthesis and growth. Sedimentation also impedes fertilization of spawned gametes and reduces larval settlement and survival of recruits and juveniles.

Nutrient Enrichment

Elevated nutrient concentrations in seawater affect corals through 2 main mechanisms: direct impacts on coral physiology, and indirect effects through stimulation of other community components (e.g., macroalgal turfs and seaweeds, and filter feeders) that compete with corals for space on the reef. Increased nutrients can decrease calcification; however, nutrients may also enhance linear extension while reducing skeletal density. Either condition results in corals that are more prone to breakage or erosion, but individual species do have varying tolerances to increased nutrients. Anthropogenic nutrients mainly come from point-source discharges (such as rivers or sewage outfalls) and surface runoff from modified watersheds. Natural processes, such as *in situ* nitrogen fixation and delivery of nutrient-rich deep water by internal waves and upwelling, also bring nutrients to coral reefs.

5.2.3 Status of Mountainous Star Coral

On September 10, 2014, NMFS listed mountainous star coral as threatened (79 FR 53851). Lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), and boulder star coral (*Orbicella franksi*) are the 3 species in the *Orbicella annularis* (star coral) complex. These 3 species were formerly in the genus *Montastraea*; however, recent work has reclassified the 3 species in the *annularis* complex to the genus *Orbicella* . The star coral species complex was historically one of the primary reef framework builders throughout the wider Caribbean. The complex was considered a highly plastic, single species –*Montastraea annularis*– with growth forms ranging from columns, to massive boulders, to plates. In the early 1990s, Weil and Knowlton suggested the partitioning of these growth forms into separate species, resurrecting the previously described taxa, *Montastraea* (now *Orbicella*) *faveolata*, and *Montastraea* (now *Orbicella*) *franksi*. These 3 species were differentiated on the basis of morphology, depth range, ecology, and behavior (Weil and Knowton 1994). Subsequent reproductive and genetic studies have supported the partitioning of the *annularis* complex into 3 species.

Some studies report on the star coral species complex rather than individual species since visual distinction can be difficult where colony morphology cannot be discerned (e.g. small colonies or photographic methods). Information from these studies is reported for the species complex. Where species-specific information is available, it is reported. However, information about *Orbicella annularis* published prior to 1994 will be attributed to the species complex since it is dated prior to the split of *Orbicella annularis* into 3 separate species.

5.2.3.1 Species Description and Distribution

Mountainous star coral grows in heads or sheets, the surface of which may be smooth or have keels or bumps. The skeleton is much less dense than in the other 2 star coral species. Colony diameters can reach up to 33 ft (10 m) with heights of 13-16 ft (4-5 m).

Mountainous star coral occurs in the western Atlantic and throughout the Caribbean, including Bahamas, Flower Garden Banks, and the entire Caribbean coastline. There is conflicting information on whether or not it occurs in Bermuda. Mountainous star coral has been reported in most reef habitats and is often the most abundant coral at 33-66 ft (10-20 m) in fore-reef environments. The depth range of mountainous star coral has been reported as approximately 1.5-132 ft (0.5-40 m), though the species complex has been reported to depths of 295 ft (90 m), indicating mountainous star coral's depth distribution is likely deeper than 132 ft (40 m). Star coral species are a common, often dominant component of Caribbean mesophotic reefs (e.g., > 100 ft [30 m]), suggesting the potential for deep refugia for mountainous star coral.

5.2.3.2 Life History Information

The star coral species complex has growth rates ranging from 0.02-0.5 in (0.06-1.2 cm) per year and averaging approximately 0.3 in (1 cm) linear growth per year. Mountainous star coral's growth rate is intermediate between the other star coral complex species (Szmant et al. 1997). They grow more slowly in deeper water and in water that is less clear.

The star coral complex species are hermaphroditic broadcast spawners,[3] as spawning is concentrated on 6-8 nights following the full moon in late August, September, or early October, depending on location and timing of full moon. All 3 species are largely self-incompatible (Knowlton et al. 1997; Szmant et al. 1997). Mountainous star coral is largely reproductively incompatible with boulder star coral and lobed star coral, and it spawns about 1-2 hours earlier. Fertilization success measured in the field was generally below 15% for all 3 species, as it is closely linked to the number of colonies concurrently spawning. In Puerto Rico, minimum size at reproduction for the star coral species complex was 12 in^2 (83 cm^2).

Successful recruitment by the star coral species complex has seemingly always been rare. Only a single recruit of *Orbicella* was observed over 18 years of intensive observation of 130 ft^2 (12 m^2) of reef in Discovery Bay, Jamaica. Many other studies throughout the Caribbean also report negligible to absent recruitment of the species complex.

Life history characteristics of mountainous star coral is considered intermediate between lobed star coral and boulder star coral especially regarding growth rates, tissue regeneration, and egg size. Spatial distribution may affect fecundity on the reef, with deeper colonies of mountainous star coral being less fecund due to greater polyp spacing. Reported growth rates of mountainous star coral range between 0.12 and 0.64 in (0.3 and 1.6 cm) per year (Cruz-Piñón et al. 2003; Tomascik 1990; Villinski 2003; Waddell 2005). Graham and van Woesik (2013) report that 44% of small colonies of mountainous star coral in Puerto Morelos, Mexico that resulted from partial colony mortality produced eggs at sizes smaller than those typically characterized as being mature. The number of eggs produced per unit area of smaller fragments was significantly less than in larger size classes. Szmant and Miller (2005) reported low post-settlement survivorship for mountainous star coral transplanted to the field with only 3-15% remaining alive after 30 days. Post-settlement survivorship was much lower than the 29% observed for elkhorn coral after 7 months (Szmant and Miller 2005).

Mountainous star coral has slow growth rates, late reproductive maturity, and low recruitment rates. Colonies can grow very large and live for centuries. Large colonies have lower total

[3] Simultaneously containing both sperm and eggs, which are released into the water column for fertilization.

mortality than small colonies, and partial mortality of large colonies can result in the production of clones. The historical absence of small colonies and few observed recruits, even though large numbers of gametes are produced on an annual basis, suggests that recruitment events are rare and were less important for the survival of the star coral species complex in the past (Bruckner 2012). Large colonies in the species complex maintain the population until conditions favorable for recruitment occur; however, poor conditions can influence the frequency of recruitment events. While the life history strategy of the star coral species complex has allowed the taxa to remain abundant, we conclude that the buffering capacity of this life history strategy has been reduced by recent population declines and partial mortality, particularly in large colonies.

5.2.3.3 Status and Population Dynamics

Information on mountainous star coral status and populations dynamics is infrequently documented throughout its range. Comprehensive and systematic census and monitoring has not been conducted. Thus, the status and populations dynamics must be inferred from the few locations were data exist.

Information regarding population structure is limited. Observations of mountainous star coral from 182 sample sites in the upper and lower Florida Keys and Mexico showed 3 well-defined populations based on 5 genetic markers, but the populations were not stratified by geography, indicating they were shared among the 3 regions (Baums et al. 2010). Of 10 mountainous star coral colonies observed to spawn at a site off Bocas del Toro, Panama, there were only 3 genotypes (Levitan et al. 2011) potentially indicating 30% clonality.

Benthic surveys along the Florida Reef Tract between 1999 and 2017 have shown a decrease of mountainous star coral (NOAA, unpublished data). In 1999, mountainous star coral was present at 62% of surveyed sites and had an average density of 0.62 colonies per m^2. Presence and density decreased substantially after 2005, and in 2017, mountainous star coral was present at 30% of sites and had an average density of 0.09 colonies per m^2.

Benthic survey data for the US Caribbean show less variability in the density of mountainous star coral. In Puerto Rico, average density was between 0.1 and 0.2 colonies per m^2 between 2008 and 2016 (NOAA, unpublished data). In 2018, average density was recorded as 0.01 colonies per m^2, the lowest recorded for all survey years. In the US Virgin Islands, density ranged from 0.01 to 0.2 colonies per m^2 between 2002 and 2017 with no obvious trends among years.

Recent events have greatly impacted coral populations in Florida and the US Caribbean. An unprecedented, multi-year disease event, which began in 2014, swept through Florida and caused massive mortality from St. Lucie Inlet in Martin County to Looe Key in the lower Florida Keys. The effects of this widespread disease have been severe, causing mortality of millions of coral colonies across several species, including mountainous star coral. At study sites in southeast Florida, prevalence of disease was recorded at 67% of all coral colonies and 81% of colonies of those species susceptible to the disease (Precht et al. 2016).

Hurricanes Irma and Maria caused substantial damage in Florida, Puerto Rico, and the US Virgin Islands in 2017. Hurricane impacts included large, overturned and dislodged coral heads and extensive burial and breakage. At 153 survey locations in Puerto Rico, approximately 12-14% of mountainous star corals were impacted (NOAA 2018). In Florida, approximately 24% of mountainous star corals surveyed at 57 sites were impacted (Florida Fish and Wildlife Conservation Commission, unpublished data). Survey data are not available for the US Virgin Islands, though qualitative observations indicate that damage was also widespread but variable by site.

In the Flower Garden Banks, limited benthic surveys show density of mountainous star coral remained relatively stable between 2010 and 2015 (NOAA, unpublished data). Average density was recorded as 0.09 colonies per m^2 in 2010, 0.19 colonies per m^2 in 2013, and 0.21 colonies per m^2 in 2015. These may represent an increasing trend as the presence of mountainous star coral also increased during this same period. It was present at 35% of sites in 2010 and increased to 68% of sites in 2013 and 77% of sites in 2015.

Limited data are available for other areas of the Caribbean. On remote reefs off southwest Cuba, average density of mountainous star coral was 0.12 colonies per 108 ft^2 (10 m^2) at 38 reef-crest sites and 1.26 colonies per 108 ft^2 (10 m^2) at 30 reef-front sites (Alcolado et al. 2010). In a survey of 31 sites in Dominica between 1999 and 2002, mountainous star coral was present at 80% of the sites at 1-10% cover (Steiner 2003a).

Population trend data exists for several locations. At 9 sites off Mona and Desecheo Islands, Puerto Rico, no species extirpations were noted at any site over 10 years of monitoring between 1998 and 2008 (Bruckner and Hill 2009). Both mountainous star coral and lobed star coral sustained large losses during the period. The number of colonies of mountainous star coral decreased by 36% and 48% at Mona and Desecheo Islands, respectively (Bruckner and Hill 2009). In 1998, 27% of all corals at 6 sites surveyed off Mona Island were mountainous star coral colonies, but this statistic decreased to approximately 11% in 2008 (Bruckner and Hill 2009). At Desecheo Island, 12% of all coral colonies were mountainous star coral in 2000, compared to 7% in 2008.

In a survey of 185 sites in 5 countries (Bahamas, Bonaire, Cayman Islands, Puerto Rico, and St. Kitts and Nevis) between 2010 and 2011, size of mountainous star coral colonies was significantly greater than boulder star coral and lobed star coral. The total mean partial mortality of mountainous star coral at all sites was 38%. The total live area occupied by mountainous star coral declined by a mean of 65%, and mean colony size declined from 43 ft^2 to 15 ft^2 (4005 cm^2 to 1413 cm^2). At the same time, there was a 168% increase in small tissue remnants less than 5 ft^2 (500 cm^2), while the proportion of completely live large (1.6 ft^2 to 32 ft^2 [1,500- 30,000 cm^2]) colonies decreased. Mountainous star coral colonies in Puerto Rico were much larger and sustained higher levels of mortality compared to the other 4 countries. Colonies in Bonaire were also large, but they experienced much lower levels of mortality. Mortality was attributed primarily to outbreaks of white plague and yellow band disease, which emerged as corals began recovering from mass bleaching events. This was followed by increased predation and removal of live tissue by damselfish to cultivate algal lawns (Bruckner 2012).

Overall, it appears that populations of mountainous star coral have been decreasing. Population decline has occurred over the past few decades with a 65% loss in mountainous star coral cover across 5 countries. Losses of mountainous star coral from Mona and Descheo Islands, Puerto Rico include a 36-48% reduction in abundance and a decrease of 42-59% in its relative abundance (i.e., proportion relative to all coral colonies). High partial mortality of colonies has led to smaller colony sizes and a decrease of larger colonies in some locations such as The Bahamas, Bonaire, Puerto Rico, Cayman Islands, and St. Kitts and Nevis. We conclude that mountainous star coral has declined and that the buffering capacity of mountainous star coral's life history strategy, which has allowed it to remain abundant, has been reduced by the recent population declines and amounts of partial mortality, particularly in large colonies. We also conclude that the population abundance is likely to decrease in the future with increasing threats.

5.2.3.4 Threats

A summary of threats to all corals is provided in Section 5.2.2 General Threats Faced by All Coral Species. Detailed information on the threats to star corals can be found in the Final Listing Rule (79 FR 53851; September 10, 2014); however, a brief summary is provided here. Mountainous star coral is highly susceptible to ocean warming, disease, ocean acidification, sedimentation, and nutrients, and susceptible to trophic effects of fishing.

Mountainous star coral is highly susceptible to elevated temperatures. In lab experiments, elevated temperatures resulted in misshapen embryos and differential gene expression in larvae that could indicate negative effects on larval development and survival. Bleaching susceptibility is generally high; 37-100% of mountainous star coral colonies have reported to bleach during several bleaching events. Chronic local stressors can exacerbate the effects of warming temperatures, which can result in slower recovery from bleaching, reduced calcification, and slower growth rates for several years following bleaching. Additionally, disease outbreaks affecting mountainous star coral have been linked to elevated temperature as they have occurred after bleaching events.

Surveys at an inshore patch reef in the Florida Keys that experienced temperatures less than 18°C for 11 days revealed species-specific cold-water susceptibility and low survivorship. Mountainous star coral was one of the more susceptible species with 90% of colonies experiencing total colony mortality, including some colonies estimated to be more than 200 years old (Kemp et al. 2011). In surveys from Martin County to the lower Florida Keys, mountainous star coral was the second most susceptible coral species, experiencing an average of 37% partial mortality (Lirman et al. 2011).

Mountainous star coral is highly susceptible to ocean acidification. Laboratory studies indicate that ocean acidification affects that mountainous star coral both through reduced fertilization of gametes and reduced growth of colonies (Carricart-Ganivet et al. 2012).

Mountainous star coral is often among the coral species with the highest disease prevalence and tissue loss. Outbreaks have been reported to affect 10-19% of mountainous star coral colonies, and yellow band disease and white plague have the greatest effect. Disease often affects larger colonies, and reported tissue loss due to disease ranges from 5-90%. Additionally, yellow band disease results in lower fecundity in diseased and recovered colonies of mountainous star coral. Therefore, we anticipate that mountainous star coral is highly susceptible to disease.

Sedimentation can cause partial mortality of mountainous star coral, and genus-level information indicates that sedimentation negatively affects primary production, growth rates, calcification, colony size, and abundance. Therefore, we anticipate that mountainous star coral is highly susceptible to sedimentation.

Although there is no species-specific information, the star coral species complex is susceptible to nutrient enrichment through reduced growth rates, lowered recruitment, and increased disease severity. Therefore, based on genus-level information, we anticipate that mountainous star coral is likely highly susceptible to nutrient enrichment.

5.2.3.5 Summary of Status

Mountainous star coral has undergone major declines mostly due to warming-induced bleaching and disease. There is evidence of synergistic effects of threats for this species including disease outbreaks following bleaching events and reduced thermal tolerance due to chronic local stressors stemming from land-based sources of pollution. Mountainous star coral is highly susceptible to a number of threats, and cumulative effects of multiple threats have likely contributed to its decline and exacerbate its vulnerability to extinction. Despite high declines, the species is still common and remains one of the most abundant species on Caribbean reefs. Its life history characteristics of large colony size and long life span have enabled it to remain relatively persistent despite slow growth and low recruitment rates, thus moderating vulnerability to extinction. The buffering capacity of these life history characteristics, however, is expected to decrease as colonies shift to smaller size classes as has been observed in locations in its range. Its absolute population abundance has been estimated as at least tens of millions of colonies in each of several locations including the Florida Keys, Dry Tortugas, and the U.S. Virgin Islands and is higher than the estimate from these 3 locations due to the occurrence of the species in many other areas throughout its range. Despite the large number of islands and environments that are included in the species' range, geographic distribution in the highly disturbed Caribbean exacerbates vulnerability to extinction over the foreseeable future because mountainous star coral is limited to an area with high, localized human impacts and predicted increasing threats. Its depth range of 0.5 m to at least 40 m, possibly up to 90 m, moderates vulnerability to extinction over the foreseeable future because deeper areas of its range will usually have lower temperatures than surface waters, and acidification is generally predicted to accelerate most in waters that are deeper and cooler than those in which the species occurs. Mountainous star coral occurs in most reef habitats, including both shallow and mesophotic reefs, which moderates vulnerability to extinction over the foreseeable future because the species occurs in numerous types of reef environments that are predicted, on local and regional scales, to experience highly variable temperatures and ocean chemistry at any given point in time. Its abundance, life history characteristics, and depth distribution, combined with spatial variability in ocean warming and acidification across the species' range, moderate vulnerability to extinction because the threats are non-uniform. Subsequently, there will likely be a large number of colonies that are either not exposed or do not negatively respond to a threat at any given point in time. We also anticipate that the population abundance is likely to decrease in the future with increasing threats.

5.2.4 Status of Lobed Star Coral

5.2.4.1 Species Description and Distribution

Lobed star coral colonies grow in columns that exhibit rapid and regular upward growth. In contrast to the other 2 star coral species, margins on the sides of columns are typically dead. Live colony surfaces usually lack ridges or bumps.

Lobed star coral is common throughout the western Atlantic Ocean and greater Caribbean Sea including the Flower Garden Banks, but may be absent from Bermuda. Lobed star coral is reported from most reef environments in depths of approximately 1.5-66 ft (0.5-20 m). The star coral species complex is a common, often dominant component of Caribbean mesophotic (e.g., >100 ft [30 m]) reefs, suggesting the potential for deep refuge across a broader depth range, but lobed star coral is generally described with a shallower distribution.

Asexual fission and partial mortality can lead to multiple clones of the same colony. The percentage of unique individuals is variable by location and is reported to range between 18% and 86% (thus, 14-82% are clones). Colonies in areas with higher disturbance from hurricanes tend to have more clonality. Genetic data indicate that there is some population structure in the eastern, central, and western Caribbean with population connectivity within but not across areas. Although lobed star coral is still abundant, it may exhibit high clonality in some locations, meaning that there may be low genetic diversity.

5.2.4.2 Life History Information

The star coral species complex has growth rates ranging from 0.02-0.5 in (0.06-1.2 cm) per year and averaging approximately 0.3 in (1 cm) linear growth per year. The reported growth rate of lobed star coral is 0.4 to 1.2 cm per year (Cruz-Piñón et al. 2003; Tomascik 1990). They grow more slowly in deeper water and in less clear water.

All 3 species of the star coral complex are hermaphroditic broadcast spawners[4], with spawning concentrated on 6-8 nights following the full moon in late August, September, or early October depending on location and timing of the full moon. All 3 species are largely self-incompatible (Knowlton et al. 1997; Szmant et al. 1997). Further, mountainous star coral is largely reproductively incompatible with boulder star coral and lobed star coral, and it spawns about 1-2 hours earlier. Fertilization success measured in the field was generally below 15% for all 3 species, as it is closely linked to the number of colonies concurrently spawning. Lobed star coral is reported to have slightly smaller egg size and potentially smaller size/age at first reproduction that the other 2 species of the *Orbicella* genus. In Puerto Rico, minimum size at reproduction for the star coral species complex was 12 in^2 (83 cm^2).

Successful recruitment by the star coral complex species has seemingly always been rare. Only a single recruit of *Orbicella* was observed over 18 years of intensive observation of 130 ft^2 (12 m^2)

[4] Simultaneously containing both sperm and eggs, which are released into the water column for fertilization.

of reef in Discovery Bay, Jamaica. Many other studies throughout the Caribbean also report negligible to absent recruitment of the species complex.

In addition to low recruitment rates, lobed star corals have late reproductive maturity. Colonies can grow very large and live for centuries. Large colonies have lower total mortality than small colonies, and partial mortality of large colonies can result in the production of clones. The historical absence of small colonies and few observed recruits, even though large numbers of gametes are produced on an annual basis, suggests that recruitment events are rare and were less important for the survival of the lobed star coral species complex in the past (Bruckner 2012). Large colonies in the species complex maintain the population until conditions favorable for recruitment occur; however, poor conditions can influence the frequency of recruitment events. While the life history strategy of the star coral species complex has allowed the taxa to remain abundant, the buffering capacity of this life history strategy has likely been reduced by recent population declines and partial mortality, particularly in large colonies.

5.2.4.3 Status and Population Dynamics

Information on lobed star coral status and populations dynamics is infrequently documented throughout its range. Comprehensive and systematic census and monitoring has not been conducted. Thus, the status and populations dynamics must be inferred from the few locations where data exist.

Lobed star coral has been described as common overall. Demographic data collected in Puerto Rico over 9 years before and after the 2005 bleaching event showed that population growth rates were stable in the pre-bleaching period (2001–2005) but declined one year after the bleaching event. Population growth rates declined even further two years after the bleaching event, but they returned and then stabilized at the lower rate the following year.

Colony density varies by habitat and location, and ranges from less than 0.1 to greater than 1 colony per approximately 100 ft^2 (10 m^2). Benthic surveys along the Florida Reef Tract between 1999 and 2017 recorded an average density of 0.01 to 0.09 colonies per m^2, and lobed star coral was observed at 4% to 16% of surveyed sites (NOAA, unpublished data). Average density of lobed star corals in Puerto Rico ranged from 0.01 to 0.08 colonies per m^2 in surveys conducted between 2008 and 2018 and was observed at 9% to 63% of surveyed sites (NOAA, unpublished data). In the US Virgin Islands, average density ranged from 0.03 to 0.21 colonies per m^2 in benthic surveys conducted between 2002 and 2017, and lobed star coral was observed at 25% to 54% of surveyed sites (NOAA, unpublished data). In the Flower Garden Banks, limited surveys detected lobed star corals at none to 24% of surveyed sites, and density was recorded as 0.1 colonies per m^2 in 2010 and 0.01 colonies per m^2 in 2013 (NOAA, unpublished data). Off southwest Cuba on remote reefs, average lobed star coral density was 0.31 colonies per approximately 108 ft^2 (10 m^2) at 38 reef-crest sites and 1.58 colonies per approximately 108 ft^2 (10 m^2) at 30 reef-front sites. Colonies with partial mortality were far more frequent than those with no partial mortality, which only occurred in the size class less than 40 in (100 cm) (Alcolado et al. 2010).

Recent events have greatly impacted coral populations in Florida and the US Caribbean. An unprecedented, multi-year disease event, which began in 2014, swept through Florida and caused massive mortality from St. Lucie Inlet in Martin County to Looe Key in the lower Florida Keys. The effects of this widespread disease have been severe, causing mortality of millions of coral colonies across several species. At study sites in southeast Florida, prevalence of disease was recorded at 67% of all coral colonies and 81% of colonies of those species susceptible to the disease (Precht et al. 2016). Lobed star coral was one of the species in surveys that showed the highest prevalence of disease, and populations were reduced to < 25% of the initial population size (Precht et al. 2016).

Hurricanes Irma and Maria caused substantial damage in Florida, Puerto Rico, and the US Virgin Islands in 2017. Hurricane impacts included large, overturned and dislodged coral heads and extensive burial and breakage. At 153 survey locations in Puerto Rico, approximately 43-44% of lobed star corals were impacted (NOAA 2018). In Florida, approximately 80% of lobed star corals surveyed at 57 sites were impacted (Florida Fish and Wildlife Conservation Commission, unpublished data). Survey data are not available for the US Virgin Islands, though qualitative observations indicate that damage was also widespread but variable by site.

Population trends are available from a number of studies. In a study of sites inside and outside a marine protected area in Belize, lobed star coral cover declined significantly over a 10-year period (1998/99 to 2008/09) (Huntington et al. 2011). In a study of 10 sites inside and outside of a marine reserve in the Exuma Cays, Bahamas, cover of lobed star coral increased between 2004 and 2007 inside the protected area and decreased outside the protected area (Mumby and Harborne 2010). Between 1996 and 2006, lobed star coral declined in cover by 37% in permanent monitoring stations in the Florida Keys (Waddell and Clarke 2008a). Cover of lobed star coral declined 71% in permanent monitoring stations between 1996 and 1998 on a reef in the upper Florida Keys (Porter et al. 2001).

Star corals are the 3rd most abundant coral by percent cover in permanent monitoring stations in the U.S. Virgin Islands. A decline of 60% was observed between 2001 and 2012 primarily due to bleaching in 2005. However, most of the mortality was partial mortality, and colony density in monitoring stations did not change (Smith 2013).

Bruckner and Hill (2009) did not note any extirpation of lobed star coral at 9 sites off Mona and Desecheo Islands, Puerto Rico, monitored between 1995 and 2008. However, mountainous star coral and lobed star coral sustained the largest losses with the number of colonies of lobed star coral decreasing by 19% and 20% at Mona and Desecheo Islands, respectively. In 1998, 8% of all corals at 6 sites surveyed off Mona Island were lobed star coral colonies, dipping to approximately 6% in 2008. At Desecheo Island, 14% of all coral colonies were lobed star coral in 2000 while 13% were in 2008 (Bruckner and Hill 2009).

In a survey of 185 sites in 5 countries (Bahamas, Bonaire, Cayman Islands, Puerto Rico, and St. Kitts and Nevis) in 2010 and 2011, the size of lobed star coral and boulder star coral colonies was significantly smaller than mountainous star coral. Total mean partial mortality of lobed star coral colonies at all sites was 40%. Overall, the total area occupied by live lobed star coral declined by a mean of 51%, and mean colony size declined from 299 in^2 to 146 in^2 (1927 cm^2 to

939 cm^2). There was a 211% increase in small tissue remnants less than 78 in^2 (500 cm^2), while the proportion of completely live large (1.6-32 ft^2 [1,500- 30,000 cm^2]) colonies declined. Star coral colonies in Puerto Rico were much larger with large amounts of dead sections. In contrast, colonies in Bonaire were also large with greater amounts of live tissue. The presence of dead sections was attributed primarily to outbreaks of white plague and yellow band disease, which emerged as corals began recovering from mass bleaching events. This was followed by increased predation and removal of live tissue by damselfish algal lawns (Bruckner 2012).

Cover of lobed star coral at Yawzi Point, St. John, U.S. Virgin Islands declined from 41% in 1988 to approximately 12% by 2003 as a rapid decline began with the aftermath of Hurricane Hugo in 1989 (Edmunds and Elahi 2007). This decline continued between 1994 and 1999 during a time of 2 hurricanes (1995) and a year of unusually high sea temperature (1998), but percent cover remained statistically unchanged between 1999 and 2003. Colony abundances declined from 47 to 20 colonies per approximately 10 ft^2 (1 m^2) between 1988 and 2003, due mostly to the death and fission of medium-to-large colonies ($\geq$ 24 in^2 [151 cm^2]). Meanwhile, the population size class structure shifted between 1988 and 2003 to a higher proportion of smaller colonies in 2003 (60% less than 7 in^2 [50 cm^2] in 1988 versus 70% in 2003) and lower proportion of large colonies (6% greater than 39 in^2 [250 cm^2] in 1988 versus 3% in 2003). The changes in population size structure indicated a population decline coincident with the period of apparent stable coral cover. Population modeling forecasted the 1988 size structure would not be reestablished by recruitment and a strong likelihood of extirpation of lobed star coral at this site within 50 years (Edmunds and Elahi 2007).

Lobed star coral colonies were monitored between 2001 and 2009 at Culebra Island, Puerto Rico. The population was in demographic equilibrium (high rates of survival and stasis) before the 2005 bleaching event, but it suffered a significant decline in growth rate (mortality and shrinkage) for 2 consecutive years after the bleaching event. Partial tissue mortality due to bleaching caused dramatic colony fragmentation that resulted in a population made up almost entirely of small colonies by 2007 (97% were less than 7 in^2 [50 cm^2]). Three years after the bleaching event, the population stabilized at about half of the previous level, with fewer medium-to-large size colonies and more smaller colonies (Hernandez-Delgado et al. 2011a).

Lobed star coral was historically considered to be one of the most abundant species in the Caribbean (Weil and Knowton 1994). Percent cover has declined by 37% to 90% over the past several decades at reefs at Jamaica, Belize, Florida Keys, The Bahamas, Bonaire, Cayman Islands, Curaçao, Puerto Rico, U.S. Virgin Islands, and St. Kitts and Nevis. Although star coral remains common in occurrence, abundance has decreased in some areas by 19% to 57%, and shifts to smaller size classes have occurred in locations such as Jamaica, Colombia, The Bahamas, Bonaire, Cayman Islands, Puerto Rico, U.S. Virgin Islands, and St. Kitts and Nevis. At some reefs, a large proportion of the population is comprised of non-fertile or less-reproductive size classes. Several population projections indicate population decline in the future is likely at specific sites, and local extirpation is possible within 25-50 years at conditions of high mortality, low recruitment, and slow growth rates. Although lobed star coral is still common throughout the Caribbean, substantial population decline has occurred. The buffering capacity of lobed star coral's life history strategy that has allowed it to remain abundant has been reduced by the recent population declines and amounts of partial mortality, particularly in large colonies. Population abundance is likely to decrease in the future with increasing threats.

5.2.4.4 Threats

A summary of threats to all corals is provided in Section 5.2.2 General Threats Faced by All Coral Species. Detailed information on the threats to lobed star coral can be found in the Final Listing Rule (79 FR 53851; September 10, 2014); however, a brief summary is provided here. Lobed star coral is highly susceptible to ocean warming, disease, ocean acidification, sedimentation, and nutrients, and susceptible to trophic effects of fishing.

Lobed star coral is highly susceptible to bleaching with 45-100% of colonies observed to bleach. Reported mortality from bleaching ranges from 2-71%. Recovery after bleaching is slow with paled colonies observed for up to a year. Reproductive failure can occur a year after bleaching, and reduced reproduction has been observed 2 years post-bleaching. There is indication that new algal symbiotic species establishment can occur prior to, during, and after bleaching events and results in bleaching resistance in individual colonies. Thus, lobed star coral is highly susceptible to ocean warming.

In a 2010 cold-water event that affected south Florida, mortality of lobed star coral was higher than any other coral species in surveys from Martin County to the lower Florida Keys. Average partial mortality was 56% during the cold-water event compared to 0.3% from 2005 to 2009. Surveys at a Florida Keys inshore patch reef, which experienced temperatures less than 18°C for 11 days, revealed lobed star coral was one of the most susceptible coral species with all colonies experiencing total colony mortality.

Although there is no species-specific information on the susceptibility of lobed star coral to ocean acidification, genus information indicates the species complex has reduced growth and fertilization success under acidic conditions. Thus, we conclude lobed star coral likely has high susceptibility to ocean acidification.

Lobed star coral is highly susceptible to disease. Most studies report lobed star coral as among the species with the highest disease prevalence. Disease can cause extensive loss in coral cover, high levels of partial colony mortality, and changes in the relative proportions of smaller and larger colonies, particularly when outbreaks occur after bleaching events.

Lobed star coral has high susceptibility to sedimentation. Sedimentation can cause partial mortality and decreased coral cover of lobed star coral. In addition, genus information indicates sedimentation negatively affects primary production, growth rates, calcification, colony size, and abundance. Lobed star coral also has high susceptibility to nutrients. Elevated nutrients cause increased disease severity in lobed star coral. Genus-level information indicates elevated nutrients also cause reduced growth rates and lowered recruitment.

5.2.4.5 Summary of Status

Lobed star coral has undergone major declines mostly due to warming-induced bleaching and disease. Several population projections indicate population decline in the future is likely at specific sites and that local extirpation is possible within 25-50 years at conditions of high mortality, low recruitment, and slow growth rates. There is evidence of synergistic effects of threats for this species, including disease outbreaks following bleaching events and increased disease severity with nutrient enrichment. Lobed star coral is highly susceptible to a number of threats, and cumulative effects of multiple threats have likely contributed to its decline and exacerbate vulnerability to extinction. Despite high declines, the species is still common and remains one of the most abundant species on Caribbean reefs. Its life history characteristics of large colony size and long life span have enabled it to remain relatively persistent despite slow growth and low recruitment rates, thus moderating vulnerability to extinction. However, the buffering capacity of these life history characteristics is expected to decrease as colonies shift to smaller size classes, as has been observed in locations in the species' range. Despite the large number of islands and environments that are included in the species' range, geographic distribution in the highly disturbed Caribbean exacerbates vulnerability to extinction over the foreseeable future because lobed star coral is limited to areas with high localized human impacts and predicted increasing threats. Star coral occurs in most reef habitats 0.5-20 m in depth which moderates vulnerability to extinction over the foreseeable future because the species occurs in numerous types of reef environments that are predicted, on local and regional scales, to experience high temperature variation and ocean chemistry at any given point in time. However, we anticipate that the population abundance is likely to decrease in the future with increasing threats.

5.2.5 Status of Boulder Star Coral

5.2.5.1 Species Description and Distribution

Boulder star coral is distinguished by large, unevenly arrayed polyps that give the colony its characteristic irregular surface. Colony form is variable, and the skeleton is dense with poorly developed annual bands. Colony diameter can reach up to 16 ft (5 m) with a height of up to 6.5 ft (2 m).

Boulder star coral is distributed in the western Atlantic Ocean and throughout the Caribbean Sea including in the Bahamas, Bermuda, and the Flower Garden Banks. Boulder star coral tends to have a deeper distribution than the other 2 species in the Orbicella species complex. It occupies most reef environments and has been reported from water depths ranging from approximately 16-165 ft (5-50 m), with the species complex reported to 250 ft (90 m). Orbicella species are a common, often dominant, component of Caribbean mesophotic reefs (e.g., >100 ft [30 m]), suggesting the potential for deep refugia for boulder star coral.

5.2.5.2 Life History Information

The star coral species complex has growth rates ranging from 0.02-0.5 in (0.06-1.2 cm) per year and averaging approximately 0.3 in (1 cm) linear growth per year. Boulder star coral is reported to be the slowest of the 3 species in the complex (Brainard et al. 2011b). They grow more slowly in deeper water and in less clear water.

All 3 species of the star coral complex are hermaphroditic broadcast spawners[5], with spawning concentrated on 6-8 nights following the full moon in late August, September, or early October, depending on timing of the full moon and location. Boulder star coral spawning is reported to be about 1- 2 hours earlier than lobed star coral and mountainous star coral. All 3 species are largely self-incompatible (Knowlton et al. 1997; Szmant et al. 1997). Fertilization success measured in the field was generally below 15% for all 3 species, as it was closely linked to the number of colonies concurrently spawning. In Puerto Rico, minimum size at reproduction for the star coral species complex was 13 in^2 (83 cm^2).

Successful recruitment by the star coral species complex appears to always have been rare. Only a single recruit of *Orbicella* was observed over 18 years of intensive observation of approximately 130 ft^2 (12 m^2) of reef in Discovery Bay, Jamaica. Many other studies throughout the Caribbean also report negligible to absent recruitment of the species complex. Of 351 colonies of boulder star coral tagged in Bocas del Toro, Panama, larger colonies were noted to spawn more frequently than smaller colonies between 2002 and 2009 (Levitan et al. 2011).

Of 351 boulder star coral colonies observed to spawn at a site off Bocas del Toro, Panama, 324 were unique genotypes. Over 90% of boulder star coral colonies on this reef were the product of sexual reproduction, and 19 genetic individuals had asexually propagated colonies made up of 2 to 4 spatially adjacent clones of each. Individuals within a genotype spawned more synchronously than individuals of different genotypes. Additionally, within 16 ft (5 m), colonies nearby spawned more synchronously than farther spaced colonies, regardless of genotype. At distances greater than 16 ft (5 m), spawning was random between colonies (Levitan et al. 2011).

In addition to low recruitment rates, boulder star corals have late reproductive maturity. Colonies can grow very large and live for centuries. Large colonies have lower total mortality than small colonies, and partial mortality of large colonies can result in the production of clones. The historical absence of small colonies and few observed recruits, even though large numbers of gametes are produced on an annual basis, suggests that recruitment events are rare and were less important for the survival of the boulder star coral species complex in the past (Bruckner 2012). Large colonies in the species complex maintain the population until conditions favorable for recruitment occur; however, poor conditions can influence the frequency of recruitment events. While the life history strategy of the star coral species complex has allowed the taxa to remain abundant, the buffering capacity of this life history strategy has likely been reduced by recent population declines and partial mortality, particularly in large colonies.

5.2.5.3 **Status and Population Dynamics**

Information on boulder star coral status and population dynamics is infrequently documented throughout its range. Comprehensive and systematic census and monitoring has not been conducted. Thus, the status and populations dynamics must be inferred from the few locations where data exist.

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[5] Simultaneously containing both sperm and eggs, which are released into the water column for fertilization.

Reported density is variable by location and habitat and is reported to range from 0.002 to 10.5 colonies per ~100 ft^2 (10 m^2). Benthic surveys conducted in Florida between 1999 and 2017 recorded an average density of 0.01 to 0.36 colonies per m^2, and boulder star coral was observed at 5% to 45% of surveyed sites (NOAA, unpublished data). In Puerto Rico, boulder star coral was observed at 3% to 50% of sites, and average density ranged from 0.002 to 0.13 colonies per m^2 in surveys conducted between 2008 and 2018 (NOAA, unpublished data). In the US Virgin Islands, boulder star coral was present at a density of 0.02 to 0.24 colonies per m^2 at 19% to 69% of sites surveyed between 1999 and 2018 (NOAA unpublished data). Limited surveys in the Flower Garden Banks reported a relatively stable density of 0.91 to 1.05 colonies per m^2 between 2010 and 2015, and boulder star coral was present at 90% to 100% of surveyed sites (NOAA, unpublished data). In a survey of 31 sites in Dominica between 1999 and 2002, boulder star coral was present in 7% of the sites at less than 1% cover (Steiner 2003a). On remote reefs off southwest Cuba, colony density was 0.08 colonies per ~100 ft^2 (10 m^2) at 38 reef-crest sites and 1.05 colonies per ~100 ft^2 (10 m^2) at 30 reef-front sites (Alcolado et al. 2010). The number of boulder star coral colonies in Cuba with partial colony mortality were far more frequent than those with no mortality across all size classes, except for 1 (i.e., less than ~20 in [50 cm]) that had similar frequency of colonies with and without partial mortality (Alcolado et al. 2010).

Abundance at some sites in Curaçao and Puerto Rico appeared to be stable over an 8-10 year period. In Curaçao, abundance was stable between 1997 and 2005, with partial mortality similar or less in 2005 compared to 1998 (Bruckner and Bruckner 2006). Abundance was also stable between 1998-2008 at 9 sites off Mona and Desecheo Islands, Puerto Rico. In 1998, 4% of all corals at 6 sites surveyed off Mona Island were boulder star coral colonies, and approximately 5% were boulder star corals in 2008; at Desecheo Island, about 2% of all coral colonies were boulder star coral in both 2000 and 2008 (Bruckner and Hill 2009).

Recent events have greatly impacted boulder star coral populations in Florida and the US Caribbean. An unprecedented, multi-year disease event, which began in 2014, swept through Florida and caused massive mortality from St. Lucie Inlet in Martin County to Looe Key in the lower Florida Keys. The effects of this widespread disease have been severe, causing mortality of millions of coral colonies across several species, including boulder star coral. At study sites in southeast Florida, prevalence of disease was recorded at 67% of all coral colonies and 81% of colonies of those species susceptible to the disease (Precht et al. 2016).

Hurricanes Irma and Maria caused substantial damage in Florida, Puerto Rico, and the US Virgin Islands in 2017. Hurricane impacts included large, overturned and dislodged coral heads and extensive burial and breakage. At 153 survey locations in Puerto Rico, approximately 10-14% of boulder star corals were impacted (NOAA 2018). In Florida, approximately 23% of boulder star corals surveyed at 57 sites were impacted (Florida Fish and Wildlife Conservation Commission, unpublished data). Survey data are not available for the US Virgin Islands, though qualitative observations indicate that damage was also widespread but variable by site.

In some locations, colony size has decreased over the past several decades. Bruckner conducted a survey of 185 sites (2010 and 2011) in 5 countries (The Bahamas, Bonaire, Cayman Islands, Puerto Rico, and St. Kitts and Nevis) and reported the size of boulder star coral and lobed star coral colonies as significantly smaller than mountainous star coral. The total mean partial mortality of boulder star coral was 25%. Overall, the total live area occupied by boulder star coral declined by a mean of 38%, and mean colony size declined from 210 in^2 to 131 in^2 (1356 cm^2 to 845 cm^2). At the same time, there was a 137% increase in small tissue remnants, along with a decline in the proportion of large (1,500 to 30,000 cm^2), completely alive colonies. Mortality was attributed primarily to outbreaks of white plague and yellow band disease, which emerged as corals began recovering from mass bleaching events. This was followed by increased predation and removal of live tissue by damselfish to cultivate algal lawns (Bruckner 2012).

Overall, abundance of boulder star coral appears stable in some locations and has declined in others. Although boulder star coral remains common, the buffering capacity of its life history strategy that has allowed it to remain abundant has been reduced by the recent population declines and amounts of partial mortality, particularly in large colonies. We anticipate that population abundance is likely to decrease in the future with increasing threats.

5.2.5.4 Threats

A summary of threats to all corals is provided in Section 5.2.2 General Threats Faced by All Coral Species. Detailed information on the threats to boulder star coral can be found in the Final Listing Rule (79 FR 53851; September 10, 2014); however, a brief summary is provided here. Boulder star coral is highly susceptible to ocean warming, disease, ocean acidification, sedimentation, and nutrients, and susceptible to trophic effects of fishing.

Available information indicates that boulder star coral is highly susceptible to warming temperatures with a reported 88-90% bleaching frequency. Reported bleaching-related mortality from one study is high at 75%. There is indication that new algal symbiotic species establishment occurs after bleaching in boulder star coral.

In a 2010 cold-water event that affected south Florida, boulder star coral ranked as the 14th most susceptible coral species out of the 25 most abundant coral species. Average partial mortality was 8% in surveys from Martin County to the lower Florida Keys after the 2010 cold-water event compared to 0.4% average mortality during summer surveys between 2005 and 2009.

Although there is no species-specific information on the susceptibility of boulder star coral to ocean acidification, genus information indicates that the species complex has reduced growth and fertilization success under acidic conditions. Thus, we conclude boulder star coral survival likely has high susceptibility to ocean acidification.

Boulder star coral is often reported as among the species with the highest disease prevalence. Although there are few quantitative studies of the effects of disease on boulder star coral, there is evidence that partial mortality can average about 25-30% and that disease can cause shifts to smaller size classes. Thus, we conclude that boulder star coral is highly susceptible to disease.

Genus information indicates sedimentation negatively affects primary production, growth rates, calcification, colony size, and abundance. Genus level information also indicates boulder star coral is likely susceptible to nutrient enrichment through reduced growth rates and lower recruitment. Additionally, nutrient enrichment has been shown to increase the severity of yellow band disease in boulder star coral. Thus, we conclude that boulder star coral survival is highly susceptible to sedimentation and nutrient enrichment.

5.2.5.5 Summary of Status

Boulder star coral has undergone declines most likely from disease and warming-induced bleaching. There is evidence of synergistic effects of threats for this species including increased disease severity with nutrient enrichment. Boulder star coral is highly susceptible to a number of threats, and cumulative effects of multiple threats have likely contributed to its decline and exacerbate vulnerability to extinction. Despite declines, the species is still common and remains one of the most abundant species on Caribbean reefs. Its life history characteristics of large colony size and long life span have enabled it to remain relatively persistent despite slow growth and low recruitment rates, thus moderating vulnerability to extinction. However, the buffering capacity of these life history characteristics is expected to decrease as colonies shift to smaller size classes as has been observed in locations in its range. Despite the large number of islands and environments that are included in the species' range, geographic distribution in the highly disturbed Caribbean exacerbates vulnerability to extinction over the foreseeable future because boulder star coral is limited to areas with high localized human impacts and predicted increasing threats. Its depth range of approximately 16-165 ft (5-50 m), possibly up to 295 ft (90 m), moderates vulnerability to extinction over the foreseeable future because deeper areas of its range will usually have lower temperatures than surface waters, and acidification is generally predicted to accelerate most in waters that are deeper and cooler than those in which the species occurs. Boulder star coral occurs in most reef habitats, including both shallow and mesophotic reefs, which moderates vulnerability to extinction over the foreseeable future because the species occurs in numerous types of reef environments that are predicted, on local and regional scales, to experience highly variable temperatures and ocean chemistry at any given point in time. However, we anticipate that the population abundance is likely to decrease in the future with increasing threats.

5.2.6 Status of Pillar Coral

On September 10, 2014, NMFS listed pillar coral as threatened (79 FR 53851).

5.2.6.1 Species Description and Distribution

Pillar coral forms cylindrical columns on top of encrusting bases. Colonies are generally grey-brown in color and may reach approximately 10 ft (3 m) in height. Polyps' tentacles remain extended during the day, giving columns a furry appearance.

Pillar coral is present in the western Atlantic Ocean and throughout the greater Caribbean Sea, though is absent from the southwest Gulf of Mexico (Tunnell 1988). Brainard et al. (2011a) identified a single known colony in Bermuda that is in poor condition. There is fossil evidence of the presence of the species off Panama less than 1,000 years ago, but it has been reported as absent today (Florida Fish and Wildlife Conservation Commission 2013). Pillar coral inhabits most reef environments in water depths ranging from approximately 3-75 ft (1-25 m), but it is most common in water between approximately 15-45 ft (5-15 m) deep (Acosta and Acevedo 2006; Cairns 1982; Goreau and Wells 1967).

5.2.6.2 Life History Information

Average growth rates of 0.7-0.8 in (1.8-2.0 cm) per year in linear extension have been reported in the Florida Keys (Hudson and Goodwin 1997) compared to 0.3 in (0.8 cm) per year as reported in Colombia and Curaçao. Partial mortality rates are size-specific with larger colonies having greater rates. Frequency of partial mortality can be high (e.g., 65% of 185 colonies surveyed in Colombia), while the amount of partial mortality per colony is generally low (average of 3% of tissue area affected per colony).

Pillar coral is a gonochoric broadcast spawning[6] species with relatively low annual egg production for its size. The combination of gonochoric spawning with persistently low population densities is expected to yield low rates of successful fertilization and low larval supply. Sexual recruitment of this species is low, and there have been no reports of juvenile colonies in the Caribbean. Spawning has been observed to occur several nights after the full moon of August in the Florida Keys (Neely et al. 2013; Waddell and Clarke 2008b) and in La Parguera, Puerto Rico (Szmant 1986). Pillar coral can also reproduce asexually by fragmentation following storms or other physical disturbance, but it is uncertain how much storm generated fragmentation contributes to asexually produced offspring.

5.2.6.3 Status and Population Dynamics

Information on pillar coral status and populations dynamics is spotty throughout its range. Comprehensive and systematic census and monitoring has not been conducted outside of Florida. Thus, the status and populations dynamics must be inferred from the few locations where data exist.

Pillar coral is uncommon but conspicuous with scattered, isolated colonies. It is rarely found in aggregations. In coral surveys, it generally has a rare encounter rate, low percent cover, and low density.

Information on pillar coral is most extensive for Florida. In surveys conducted between 1999 and 2017, pillar coral was present at 0% to 13% of sites surveyed, and average density ranged from 0.0002 to 0.004 colonies per m^2 (NOAA, unpublished data). In 2014, there were 714 known colonies of pillar coral along the Florida reef tract from southeast Florida to the Dry Tortugas. In 2014, pillar coral colonies began to suffer from disease most likely associated with multiple years of warmer than normal temperatures. By April 2018, 75% of recorded colonies had suffered complete mortality (K. Neely and C. Lewis, unpublished data). The majority of these colonies were lost from the northern portion of the reef tract (Figure 17).

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[6] Parents only contain one gamete (egg or sperm), which are released into the water column for fertilization by another parent's gamete.

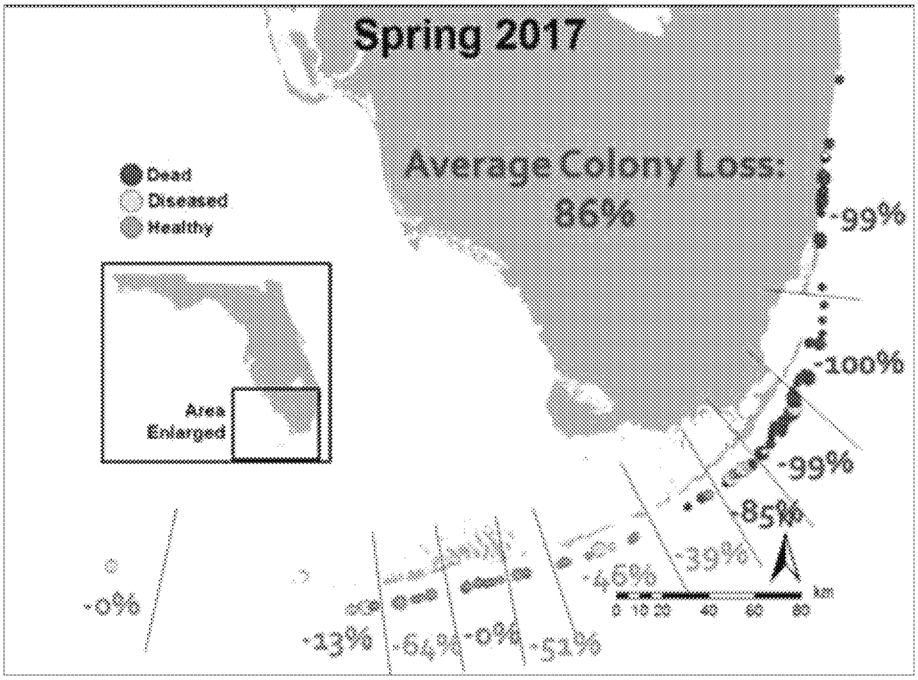

Figure 17. Condition of known pillar coral colonies in Florida between 2014 and 2017 (Figure curtesy of K. Neely and C. Lewis).

Density of pillar corals in other areas of the Caribbean is also low and on average less than 0.1 colonies per 10 m^2. The average number of pillar coral colonies in remote reefs off southwest Cuba was 0.013 colonies per 10 m^2 (approximately 108 ft^2), and the species ranked sixth rarest out of 38 coral species (Alcolado et al. 2010). In a study of pillar coral demographics at Providencia Island, Colombia, a total of 283 pillar coral colonies were detected in a survey of 1.66 km^2 (0.6 square miles) for an overall density of approximately 0.000017 colonies per 10 m^2 (approximately 100 ft^2)(Acosta and Acevedo 2006). In Puerto Rico, average density of pillar coral ranged from 0.0003 to 0.01 colonies per m^2 (approximately 100 ft^2); it occurred at 1% to 18% of the sites surveyed between 2008 and 2018 (NOAA unpublished data). In the US Virgin Islands, average density of pillar coral ranged between 0.0003 and 0.005 colonies per m^2 (approximately 100 ft^2); it occurred in 1% to 6% of the sites surveyed between 2002 and 2017 (NOAA unpublished data). In Dominica, pillar coral comprised less than 0.9% cover and was present at 13% of 31 surveyed sites (Steiner 2003b). Pillar coral was observed on 1 of 7 fringing reefs surveyed off Barbados, and average cover was 3% (Tomascik and Sander 1987).

Hurricanes Irma and Maria caused substantial damage in Florida, Puerto Rico, and the US Virgin Islands in 2017. Hurricane impacts included large, overturned and dislodged coral heads and extensive burial and breakage. At 153 survey locations in Puerto Rico, approximately 46% to 77% of pillar corals were impacted (NOAA 2018). In a post-hurricane survey of 57 sites in Florida, no pillar coral colonies were encountered, likely reflecting their much reduced population from disease (Florida Fish and Wildlife Conservation Commission, unpublished data). Survey data are not available for the US Virgin Islands, though qualitative observations indicate that damage was also widespread but variable by site.

Other than the declining population in Florida, there are two reports of population trends from the Caribbean. In monitored photo-stations in Roatan, Honduras, cover of pillar coral increased slightly from 1.35% in 1996 to 1.67% in 1999 and then declined to 0.44% in 2003 and to 0.43% in 2005 (Riegl et al. 2009). In the U.S. Virgin Islands, 7% of 26 monitored colonies experienced total colony mortality between 2005 and 2007, though the very low cover of pillar coral (0.04%) remained relatively stable during this time period (Smith et al. 2013).

Pillar coral is currently uncommon to rare throughout Florida and the Caribbean. Low abundance and infrequent encounter rate in monitoring programs result in small samples sizes. The low coral cover of this species renders monitoring data difficult to extrapolate to realize trends. The studies that report pillar coral population trends indicate some decline with severe declines in Florida. Low density and gonochoric broadcast spawning reproductive mode, coupled with no observed sexual recruitment, indicate that natural recovery potential from mortality is low.

5.2.6.4 Threats

A summary of threats to all corals is provided in Section 5.2.2 General Threats Faced by All Coral Species. Detailed information on the specific threats to pillar coral can be found in the Final Listing Rule (79 FR 53851; September 10, 2014); however, a brief summary is provided here. Pillar coral is susceptible to ocean warming, disease, ocean acidification, sedimentation, and nutrients, and the trophic effects of fishing.

Pillar coral appears to have some susceptibility to ocean warming, though there are conflicting characterizations of the susceptibility of pillar coral to bleaching. Some locations experienced high bleaching of up to 100% of pillar coral colonies during the 2005 Caribbean bleaching event (Oxenford et al. 2008) while others had a smaller proportion of colonies bleach (e.g., 36%; Bruckner and Hill 2009). Reports of low mortality after less severe bleaching indicate potential resilience, though mortality information is absent from locations that reported high bleaching frequency. Although bleaching of most coral species is spatially and temporally variable, understanding the susceptibility of pillar coral is further confounded by the species' rarity and, hence, low sample size in any given survey.

Pillar coral is sensitive to cold temperatures. In laboratory studies of cold shock, pillar coral had the most severe bleaching of the 3 species tested at 12°C (Muscatine et al. 1991). During the 2010 cold water event in the Florida Keys, pillar coral experienced 100% mortality on surveyed inshore reefs, while other species experienced lower mortality (Kemp et al. 2011).

Pillar coral is susceptible to black band disease and white plague, though impacts from white plague are likely more extensive because of rapid progression rates (Brainard et al. 2011a). Disease appears to be present in about 3-4% of pillar coral populations in locations surveyed (Acosta and Acevedo 2006; Ward et al. 2006). Because few studies have tracked disease progression in pillar coral, the effects of disease are uncertain at both the colony and population level. However, in Florida where all known colonies of pillar coral were regularly monitored, extensive partial and whole colony mortality due to disease occurred in a large portion of the reef tract, reducing the overall number of pillar coral colonies in Florida by 57% and virtually eliminating pillar coral from the northern-most portion of its range (Figure 17).

Pillar coral appears to be moderately capable of removing sediment from its tissue (Brainard et al. 2011a). However, pillar coral may be more sensitive to turbidity due to its high reliance on nutrition from photosynthesis (Brainard et al. 2011a) and as evidenced by the geologic record (Hunter and Jones 1996). Pillar coral may also be susceptible to nutrient enrichment as evidenced by its absence from eutrophic sites in Barbados (Brainard et al. 2011a), but there is uncertainty about whether its absence is a result of eutrophic conditions or a result of its naturally uncommon or rare occurrence. We anticipate that pillar coral likely has some susceptibility to sedimentation and nutrient enrichment. The available information does not support a more precise description of its susceptibility to this threat.

5.2.5.6 Summary of Status

Pillar coral is susceptible to a number of threats, and there is evidence of population declines in some locations and severe declines in Florida. Despite the large number of islands and environments that are included in the species' range, geographic distribution in the highly disturbed Caribbean exacerbates vulnerability to extinction over the foreseeable future because pillar coral is limited to an area with high, localized human impacts and predicted increasing threats. Pillar coral inhabits most reef environments in water depths ranging from 3-82 ft (1-25 m), but is naturally rare. It is a gonochoric broadcast spawner with observed low sexual recruitment. Its low abundance, combined with its geographic location, exacerbates vulnerability to extinction. This is because increasingly severe conditions within the species' range are likely to affect a high proportion of its population at any given point in time. Also, low sexual recruitment, combined with its gonochoric, broadcast spawning reproduction mode and low density, is likely to inhibit recovery potential from mortality events, further exacerbating its vulnerability to extinction. We anticipate that pillar coral is likely to decrease in abundance in the future with increasing threats.

5.2.6 Status of Rough Cactus Coral

On September 10, 2014, NMFS listed rough cactus coral as threatened (79 FR 53851).

5.2.6.1 Species Description and Distribution

Rough cactus coral forms a thin, encrusting plate that is weakly attached to substrate. Rough cactus coral is taxonomically distinct (i.e., separate species), though difficult to distinguish in the field from other *Mycetophyllia* species. Maximum colony size is 20 in (50 cm) in diameter.

Rough cactus coral occurs in the western Atlantic Ocean and throughout the wider Caribbean Sea. It has not been reported in the Flower Garden Banks (Gulf of Mexico) or in Bermuda. It inhabits reef environments in water depths of 16-295 ft (5-90 m), including shallow and mesophotic habitats (e.g., > 100 ft [30 m]).

5.2.6.2 Life History Information

Rough cactus coral is a hermaphroditic brooding[7] species. Colony size at first reproduction is greater than 15 in^2 (100 cm^2). Recruitment of rough cactus coral appears to be very low, even in studies from the 1970s. Rough cactus coral has a lower fecundity compared to other species in its genus (Morales Tirado 2006). Over a 10-year period, no colonies of rough cactus coral were observed to recruit to an anchor-damaged site in the U.S. Virgin Islands, although adults were observed on the adjacent reef (Rogers and Garrison 2001). No other life history information appears to exist for rough cactus coral.

5.2.6.3 Status and Population Dynamics

Information on rough cactus coral status and populations dynamics is infrequently documented throughout its range. Comprehensive and systematic census and monitoring has not been conducted. Thus, the status and populations dynamics must be inferred from the few locations where data exist.

Rough cactus corals are uncommon and typically occur at an average density of <0.001 to 0.02 colonies per m^2. In benthic surveys conducted in the US Virgin Islands between 2002 and 2018, rough cactus corals were encountered in less than half of the survey years, and density was ≤0.001 colonies per m^2 at the 1% to 2% of sites where they occurred (NOAA, unpublished data). Rough cactus corals were present at 8% of sites surveyed in Puerto Rico in 2008, but in surveys conducted between 2010 and 2018, they were found at 1% to 4% of surveyed sites at an average density of <0.001 to 0.004 colonies per m^2 (NOAA, unpublished data). Rough cactus corals were encountered in 2% to 10% of sites surveyed in Florida between 1999 and 2006, but in surveys between 2007 and 2017, they were only encountered in three survey years and at only 1% of sites at an average density of <0.001 colonies per m^2 (NOAA, unpublished data). Density of rough cactus coral in southeast Florida and the Florida Keys was approximately 0.8 colonies per approximately 100 ft^2 (10 m^2) between 2005 and 2007 (Wagner et al. 2010). In a survey of 97 stations in the Florida Keys, rough cactus coral declined in occurrence from 20 stations in 1996 to 4 stations in 2009 (Brainard et al. 2011a). At 21 stations in the Dry Tortugas, rough cactus coral declined in occurrence from 8 stations in 2004 to 3 stations in 2009 (Brainard et al. 2011a). Taken together, these data indicate that the species has declined in Florida and potentially also in Puerto Rico over the past one to two decades.

A recent coral disease event has greatly affected coral populations in Florida. This unprecedented, multi-year disease event, which began in 2014, swept through Florida and caused massive mortality from St. Lucie Inlet in Martin County to Looe Key in the lower Florida Keys. The effects of this widespread disease have been severe, causing mortality of millions of coral colonies across several species, including *Mycetophyllia* species. At study sites in southeast Florida, prevalence of disease was recorded at 67% of all coral colonies and 81% of colonies of those species susceptible to the disease (Precht et al. 2016). No species-specific information is available for the effects of disease on rough cactus coral, but in a survey of 134 sites conducted between October 2017 and April 2018, 9% of *Mycetophyllia* species were affected (Neely 2018).

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[7] Simultaneously containing both sperm and eggs, which are fertilized within the parent colony and grows for a period before release.

This disease prevalence is a snapshot in time and does not represent the total proportion of *Mycetophyllia* species affected by the disease outbreak.

Average benthic cover of rough cactus coral in the Red Hind Marine Conservation District off St. Thomas, U.S. Virgin Islands, which includes mesophotic coral reefs, was 0.003% in 2007, accounting for 0.02% of coral cover, and ranking 19 out of 21 coral species (Nemeth et al. 2008; Smith et al. 2010). In the U.S. Virgin Islands between 2001 and 2012, rough cactus coral appeared in 12 of 33 survey sites and accounted for 0.01% of the colonized bottom and 0.07% of the coral cover, ranking as 13th most common coral on the reef (Smith 2013).

In other areas of the Caribbean, rough cactus coral is also uncommon. In a survey of Utila, Honduras between 1999 and 2000, rough cactus coral was observed at 8% of 784 surveyed sites and was the 36th most commonly observed out of 46 coral species; other *Mycetophyllia* species were seen more commonly (Afzal et al. 2001). In surveys of remote southwest reefs of Cuba, rough cactus coral was observed at 1 of 38 reef-front sites, where average abundance was 0.004 colonies per approximately 108 ft^2 (10 m^2); this was comparatively lower than the other 3 *Mycetophyllia* species observed (Alcolado et al. 2010). Between 1998 and 2004, rough cactus coral was observed at 3 of 6 sites monitored in Colombia, where their cover ranged from 0.3-0.4% (Rodriguez-Ramirez et al. 2010). In Barbados, rough cactus coral was observed on 1 of 7 reefs surveyed, and the average cover was 0.04% (Tomascik and Sander 1987).

Rough cactus coral has been reported to occur on a low percentage of surveyed reefs and is one of the least common coral species observed. On reefs where rough cactus coral is found, it generally occurs at abundances of less than 1 colony per approximately 100 ft^2 (10 m^2) and cover of less than 0.1%. Low encounter rate and percent cover coupled with the tendency to include *Mycetophyllia* spp. at the genus level make it difficult to discern population trends of rough cactus coral from monitoring data. However, reported losses of rough cactus coral from monitoring stations in the Florida Keys and Dry Tortugas (63-80% loss) and decreased encounter frequency in Puerto Rico indicate the population has declined.

5.2.6.3 Threats

A summary of threats to all corals is provided in Section 5.2.2 General Threats Faced by All Coral Species. Detailed information on the threats to rough cactus coral can be found in the Final Listing Rule (79 FR 53851; September 10, 2014); however, a brief summary is provided here. Rough cactus coral is highly susceptible to disease, and susceptible to ocean warming, acidification, trophic effects of fishing, nutrients, and sedimentation.

Rough cactus coral has some susceptibility to ocean warming. However, the available information does not support a more precise description of susceptibility to this threat. The bleaching reports available specifically for rough cactus coral and at the genus level indicate similar trends of relatively low bleaching observed in 1995, 1998, and 2010 (less than 25%). Further in the more severe 2005 bleaching event, higher beaching levels (50-65%) or no bleaching, were observed in different locations in its range. Reproductive failure and a disease outbreak were reported for the genus after the 2005 bleaching event. Although bleaching of most coral species is spatially and temporally variable, understanding the susceptibility of rough cactus coral is somewhat confounded by the species' low sample size in any given survey due to its low encounter rate.

Rough cactus coral is highly susceptible to disease. Reports in the Florida Keys indicate rough cactus coral is very susceptible to white plague, and reports of high losses and correlation with higher temperatures date back to the mid-1970s (Dustan 1977). Although heavy impacts of disease on rough cactus coral have not been reported in other locations, an outbreak of white plague was credited with causing heavy mortality at the genus level in Puerto Rico after the 2005 bleaching event (Wilkinson 2008).

Rough cactus coral may be susceptible to nutrient enrichment as evidenced by its absence from eutrophic sites in one location. However, there is uncertainty about whether the absence is a result of eutrophic conditions or a result of uncommon or rare occurrence. Therefore, we conclude that rough cactus coral likely has some susceptibility to nutrient enrichment. However, the available information does not support a more precise description of susceptibility.

5.2.6.4 **Summary of Status**

Rough cactus coral has declined due to disease in at least a portion of its range and has low recruitment, which limits its capacity for recovery from mortality events and exacerbates vulnerability to extinction. Despite the large number of islands and environments that are included in the species' range, geographic distribution in the highly disturbed Caribbean exacerbates vulnerability to extinction over the foreseeable future because rough cactus coral is limited to an area with high, localized human impacts and predicted increasing threats. Its depth range of 5 to 90 m moderates vulnerability to extinction over the foreseeable future because deeper areas of its range will usually have lower temperatures than surface waters. Acidification is predicted to accelerate most in deeper and cooler waters than those in which the species occurs. Its habitat includes shallow and mesophotic reefs which moderates vulnerability to extinction over the foreseeable future because the species occurs in numerous types of reef environments that are predicted, on local and regional scales, to experience highly variable thermal regimes and ocean chemistry at any given point in time. Rough cactus coral is usually uncommon to rare throughout its range. Its abundance, combined with spatial variability in ocean warming and acidification across the species' range, moderate vulnerability to extinction because the threats are non-uniform. Subsequently, there will likely be a large number of colonies that are either not exposed or do not negatively respond to a threat at any given point in time. However, we anticipate that the population abundance is likely to decrease in the future with increasing threats.

5.2.7 Status of Elkhorn Coral

Elkhorn coral was listed as threatened under the ESA in May 2006 (71 FR 26852). In December 2012, NMFS proposed changing its status from threatened to endangered (77 FR 73219). On September 10, 2014, NMFS determined that elkhorn coral should remain listed as threatened (79 FR 53851).

5.2.7.1 Species Description and Distribution

Elkhorn coral colonies have frond-like branches, which appear flattened to near round, and typically radiate out from a central trunk and angle upward. Branches are up to approximately 20 in (50 cm) wide and range in thickness from about 1.5-2 in (4 to 5 cm). Individual colonies can grow to at least 6.5 ft (2 m) in height and 13 ft (4 m) in diameter (*Acropora* Biological Review Team 2005). Colonies of elkhorn coral can grow in nearly single-species, dense stands and form an interlocking framework known as thickets.

Elkhorn coral is distributed throughout the western Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. The northern extent of the range in the Atlantic is Broward County, Florida, where it is relatively rare (only a few known colonies), but fossil elkhorn coral reef framework extends into Palm Beach County, Florida. There are 2 known colonies of elkhorn coral, which were discovered in 2003 and 2005, at the Flower Garden Banks, which is located 100 miles (161 km) off the coast of Texas in the Gulf of Mexico (Zimmer et al. 2006). The species has been affected by extirpation from many localized areas throughout its range (Jackson et al. 2014).

Goreau (1959) described 10 habitat zones on a Jamaican fringing reef from inshore to the deep slope, finding elkhorn coral in 8 of the 10 zones. Elkhorn coral commonly grows in turbulent water on the fore-reef, reef crest, and shallow spur-and-groove zone (Cairns 1982; Miller et al. 2008; Rogers et al. 1982; Shinn 1963) in water ranging from approximately 3-15 ft (1-5 m) depth, and up to 40 ft (12m). Elkhorn coral often grows in thickets in fringing and barrier reefs (Jaap 1984; Tomascik and Sander 1987; Wheaton and Jaap 1988). They have formed extensive barrier-reef structures in Belize (Cairns 1982), the greater and lesser Corn Islands, Nicaragua (Lighty et al. 1982), and Roatan, Honduras, and extensive fringing reef structures throughout much of the Caribbean (Adey 1978). Early studies termed the reef crest and adjacent seaward areas from the surface down to approximately 20 ft (5-6 m) depth the "palmata zone" because of the domination by the species (Goreau 1959; Shinn 1963). It also occasionally occurs in back-reef environments and in depths up to 98 ft (30 m).

5.2.7.2 Life History Information

Relative to other corals, elkhorn coral has a high growth rate allowing acroporid reef growth to keep pace with past changes in sea level (Fairbanks 1989). Growth rates, measured as skeletal extension of the end of branches, range from approximately 2-4 in (4-11 cm) per year (*Acropora* Biological Review Team 2005). However, growth rates in Curaçao have been reported to be slower today than they were several decades ago (Brainard et al. 2011a). Annual growth has been found to be dependent on the size of the colony, and new recruits and juveniles typically grow at slower rates. Additionally, stressed colonies and fragments may also exhibit slower growth.

Elkhorn coral is a hermaphroditic broadcast spawning[8] species that reproduces sexually after the full moon of July, August, and/or September, depending on location and timing of the full moon (Acropora Biological Review Team 2005). Split spawning (spawning over a 2 month period) has been reported from the Florida Keys (Fogarty et al. 2012). The estimated size at sexual

[8] Simultaneously containing both sperm and eggs, which are released into the water column for fertilization.

maturity is approximately 250 in^2 (1,600 cm^2), and growing edges and encrusting base areas are not fertile (Soong and Lang 1992). Larger colonies have higher fecundity per unit area, as do the upper branch surfaces (Soong and Lang 1992). Although self-fertilization is possible, elkhorn coral is largely self-incompatible (Baums et al. 2005a; Fogarty et al. 2012).

Sexual recruitment rates are low, and this species is generally not observed in coral settlement studies in the field. Rates of post-settlement mortality after 9 months are high based on settlement experiments (Szmant and Miller 2006). Laboratory studies have found that certain species of crustose-coralline algae facilitate larval settlement and post-settlement survival (Ritson-Williams et al. 2010). Laboratory experiments have shown that some individuals (i.e., genotypes) are sexually incompatible (Baums et al. 2013) and that the proportion of eggs fertilized increases with higher sperm concentration (Fogarty et al. 2012). Experiments using gametes collected in Florida and Belize showed that Florida corals had lower fertilization rates than those from Belize, possibly due to genotype incompatibilities (Fogarty et al. 2012).

Reproduction occurs primarily through asexual fragmentation that produces multiple colonies that are genetically identical (Bak and Criens 1982; Highsmith 1982; Lirman 2000; Miller et al. 2007; Wallace 1985). Storms can be a method of producing fragments to establish new colonies (Fong and Lirman 1995). Fragmentation is an important mode of reproduction in many reef-building corals, especially for branching species such as elkhorn coral (Highsmith 1982; Lirman 2000; Wallace 1985). However, in the Florida Keys where populations have declined, there have been reports of failure of asexual recruitment due to high fragment mortality after storms (Porter et al. 2012; Williams and Miller 2010; Williams et al. 2008).

The combination of relatively rapid skeletal growth rates and frequent asexual reproduction by fragmentation can enable effective competition within, and domination of, elkhorn coral in reef-high-energy environments such as reef crests. Rapid skeletal growth rates and frequent asexual reproduction by fragmentation facilitate potential recovery from disturbances when environmental conditions permit (Highsmith 1982; Lirman 2000). However, low sexual reproduction can lead to reduced genetic diversity and limits the capacity to repopulate sites distant from the parent.

5.2.7.3 Status and Population Dynamics

Information on elkhorn coral status and populations dynamics is spotty throughout its range. Comprehensive and systematic census and monitoring has not been conducted. Thus, the status and populations dynamics must be inferred from the few locations were data exist.

There appear to be two distinct populations of elkhorn coral. Genetic samples from 11 locations throughout the Caribbean indicate that elkhorn coral populations in the eastern Caribbean (St. Vincent and the Grenadines, U.S. Virgin Islands, Curaçao, and Bonaire) have had little or no genetic exchange with populations in the western Atlantic and western Caribbean (Bahamas, Florida, Mexico, Panama, Navassa, and Puerto Rico) (Baums et al. 2005b). While Puerto Rico is more closely connected with the western Caribbean, it is an area of mixing with contributions from both regions (Baums et al. 2005b). Models suggest that the Mona Passage between the

Dominican Republic and Puerto Rico acts as a filter for larval dispersal and gene flow between the eastern Caribbean and western Caribbean (Baums et al. 2006b).

The western Caribbean is characterized by genetically poor populations with lower densities (0.13 ± 0.08 colonies per m^2). The eastern Caribbean populations are characterized by denser (0.30 ± 0.21 colonies per m^2), genotypically richer stands (Baums et al. 2006a). Baums et al. (2006a) concluded that the western Caribbean had higher rates of asexual recruitment and that the eastern Caribbean had higher rates of sexual recruitment. They postulated these geographic differences in the contribution of reproductive modes to population structure may be related to habitat characteristics, possibly the amount of shelf area available.

Genotypic diversity is highly variable. At two sites in the Florida Keys, only one genotype per site was detected out of 20 colonies sampled at each site (Baums et al. 2005b). In contrast, all 15 colonies sampled in Navassa had unique genotypes (Baums et al. 2006a). Some sites have relatively high genotypic diversity such as in Los Roques, Venezuela (118 unique genotpyes out of 120 samples; Zubillaga et al. 2008) and in Bonaire and Curaçao (18 genotypes of 22 samples and 19 genotypes of 20 samples, respectively; Baums et al. 2006a). In the Bahamas, about one third of the sampled colonies were unique genotypes, and in Panama between 24% and 65% of the sampled colonies had unique genotypes, depending on the site (Baums et al. 2006a).

A genetic study found significant population structure in Puerto Rico locations (Mona Island, Desecheo Island, La Parguerain, La Parguera) both between reefs and between locations. The study suggests that there is a restriction of gene flow between some reefs in close proximity in the La Parguera reefs resulting in greater population structure (Garcia Reyes and Schizas 2010). A more recent study provided additional detail on the genetic structure of elkhorn coral in Puerto Rico, as compared to Curaçao, the Bahamas, and Guadeloupe that found unique genotypes in 75% of the samples with high genetic diversity (Mège et al. 2014). The recent results support two separate populations of elkhorn coral in the eastern Caribbean and western Caribbean; however, there is less evidence for separation at Mona Passage, as found by Baums et al. (2006b).

Elkhorn coral was historically one of the dominant species on Caribbean reefs, forming large, monotypic thickets and giving rise to the "elkhorn" zone in classical descriptions of Caribbean reef morphology (Goreau 1959). However, mass mortality, apparently from white-band disease (Aronson and Precht 2001), spread throughout the Caribbean in the mid-1970s to mid-1980s and precipitated widespread and radical changes in reef community structure (Brainard et al. 2011a). This mass mortality occurred throughout the range of the species within all Caribbean countries and archipelagos, even on reefs and banks far from localized human influence (Aronson and Precht 2001; Wilkinson 2008). In addition, continuing coral mortality from periodic acute events such as hurricanes, disease outbreaks, and mass bleaching events added to the decline of elkhorn coral (Brainard et al. 2011a). In locations where historic quantitative data are available (Florida, Jamaica, U.S. Virgin Islands), there was a reduction of greater than 97% between the 1970s and early 2000s in elkhorn coral populations (Acropora Biological Review Team 2005).

Since the 2006 listing of elkhorn coral, continued population declines have occurred in some locations with certain populations of elkhorn coral decreasing up to an additional 50% or more

(Colella et al. 2012; Lundgren and Hillis-Starr 2008; Muller et al. 2008; Rogers and Muller 2012; Williams et al. 2008). In addition, Williams et al. (2008) reported asexual recruitment failure between 2004 and 2007 in the upper Florida Keys after a major hurricane season in 2005 where less than 5% of the fragments produced recruited into the population. In contrast, several studies describe elkhorn coral populations that are showing some signs of recovery or are stable including in the Turks and Caicos Islands (Schelten et al. 2006), U.S. Virgin Islands (Grober-Dunsmore et al. 2006; Mayor et al. 2006; Rogers and Muller 2012), Venezuela (Zubillaga et al. 2008), and Belize (Macintyre and Toscano 2007).

There is some density data available for elkhorn corals in Florida, Puerto Rico, the US Virgin Islands, and Cuba. In Florida, elkhorn coral was detected at 0% to 78% of the sites surveyed between 1999 and 2017. Average density ranged from 0.001 to 0.12 colonies per m^2 (NOAA, unpublished data). Elkhorn coral was encountered less frequently during benthic surveys in the US Virgin Islands from 2002 to 2017. It was observed at 0 to 7% of surveyed reefs, and average density ranged from 0.001 to 0.01 colonies per m^2 (NOAA, unpublished data). Maximum elkhorn coral density at ten sites in St. John, U.S. Virgin Islands was 0.18 colonies per m^2 (Muller et al. 2014). In Puerto Rico, average density ranged from 0.002 to 0.09 colonies per m^2 in surveys conducted between 2008 and 2018, and elkhorn coal was observed on 1% to 27% of surveyed sites (NOAA, unpublished data). Density estimates from sites in Cuba range from 0.14 colonies per m^2 (Alcolado et al. 2010) to 0.18 colonies per m^2 (González-Díaz et al. 2010).

Mayor et al. (2006) reported the abundance of elkhorn coral in Buck Island Reef National Monument, St. Croix, U.S. Virgin Islands. They surveyed 617 sites from May to June 2004 and extrapolated density observed per habitat type to total available habitat. Within an area of 795 ha, they estimated 97,232–134,371 (95% confidence limits) elkhorn coral colonies with any dimension of connected live tissue greater than one meter. Mean densities (colonies $\geq$ 1 m) were 0.019 colonies per m^2 in branching coral-dominated habitats and 0.013 colonies per m^2 in other hard bottom habitats.

Puerto Rico contains the greatest known extent of elkhorn coral in the U.S. Caribbean; however, the species is still rarely encountered. Between 2006 and 2007, a survey of 431 random points in habitat suitable for elkhorn coral in 6 marine protected areas in Puerto Rico revealed a variable density of 0-52 elkhorn coral colonies per 100 m^2, with average density of 0.03 colonies per m^2. Live elkhorn coral colonies were present at 31% of all points sampled, and total loss of elkhorn coral was evidenced in 14% of the random survey areas where only dead standing colonies were present (Schärer et al. 2009).

In stratified random surveys along the south, southeast, southwest, and west coasts of Puerto Rico designed to locate *Acropora* colonies, elkhorn coral was observed at 5 out of 301 stations with sightings outside of the survey area at an additional 2 stations (García Sais et al. 2013). Elkhorn coral colonies were absent from survey sites along the southeast coast. Maximum density was 18 colonies per 15 m^2 (1.2 colonies per m^2), and maximum colony size was approximately 7.5 ft (2.3 m) in diameter (García Sais et al. 2013).

Demographic monitoring of elkhorn coral colonies in Florida has shown a decline over time. Upper Florida Keys colonies showed more than 50% loss of tissue as well as a decline in the number of colonies, and a decline in the dominance by large colonies between 2004 and 2010 (Vardi et al. 2012; Williams and Miller 2012). Elasticity analysis from a population model based on data from the Florida Keys has shown that the largest individuals have the greatest contribution to the rate of change in population size (Vardi et al. 2012). Between 2010 and 2013, elkhorn coral in the middle and lower Florida Keys had mixed trends. Population densities remained relatively stable at 2 sites and decreased at 2 sites by 21% and 28% (Lunz 2013). Following the 2014 and 2015 thermal stress events, monitored elkhorn coral colonies lost one-third of their live tissue (Williams et al. 2017).

Hurricanes Irma and Maria caused substantial damage in Florida, Puerto Rico, and the US Virgin Islands in 2017. Hurricane impacts included large, overturned and dislodged coral heads and extensive burial and breakage. At 153 survey locations in Puerto Rico, approximately 45% to 77% of elkhorn corals were impacted (NOAA 2018). Survey data for impacts to elkhorn corals are not available for the US Virgin Islands or Florida, though qualitative observations indicate that damage was also widespread but variable by site.

At 8 of 11 sites in St. John, U.S. Virgin Islands, colonies of elkhorn coral increased in abundance, between 2001 and 2003, particularly in the smallest size class, with the number of colonies in the largest size class decreasing (Grober-Dunsmore et al. 2006). Colonies of elkhorn coral monitored monthly between 2003 and 2009 in Haulover Bay on St. John, U.S. Virgin Islands suffered bleaching and mortality from disease but showed an increase in abundance and size at the end of the monitoring period (Rogers and Muller 2012). The overall density of elkhorn coral colonies around St. John did not significantly differ between 2004 and 2010 with 6 out of the 10 sites showing an increase in colony density. Size frequency distribution did not significantly change at 7 of the 10 sites, with 2 sites showing an increased abundance of large-sized (> 51 cm) colonies (Muller et al. 2014).

In Curaçao, elkhorn coral monitored between 2009 and 2011 decreased in abundance and increased in colony size, with stable tissue abundance following hurricane damage (Bright et al. 2013). The authors explained that the apparently conflicting trends of increasing colony size but similar tissue abundance likely resulted from the loss of small-sized colonies that skewed the distribution to larger size classes, rather than colony growth.

Simulation models using data from matrix models of elkhorn coral colonies from specific sites in Curaçao (2006-2011), the Florida Keys (2004-2011), Jamaica (2007-2010), Navassa (2006 and 2009), Puerto Rico (2007 and 2010), and the British Virgin Islands (2006 and 2007) indicate that most of these studied populations will continue to decline in size and extent by 2100 if environmental conditions remain unchanged (i.e., disturbance events such as hurricanes do not increase; Vardi 2011). In contrast, the studied populations in Jamaica were projected to increase in abundance, and studied populations in Navassa were projected to remain stable. Studied populations in the British Virgin Islands were predicted to decrease slightly from their initial very low levels. Studied populations in Florida, Curaçao, and Puerto Rico were predicted to decline to zero by 2100. Because the study period did not include physical damage (storms), the population simulations in Jamaica, Navassa, and the British Virgin Islands may have contributed to the differing projected trends at sites in these locations.

A report on the status and trends of Caribbean corals over the last century indicates that cover of elkhorn coral has remained relatively stable at approximately 1% throughout the region since the large mortality events of the 1970s and 1980s. The report also indicates that the number of reefs with elkhorn coral present steadily declined from the 1980s to 2000-2004, then remained stable between 2000-2004 and 2005-2011. Elkhorn coral was present at about 20% of reefs surveyed in both the 5-year period of 2000-2004 and the 7-year period of 2005-2011. Elkhorn coral was dominant on approximately 5 to 10% of hundreds of reef sites surveyed throughout the Caribbean during the 4 periods of 1990-1994, 1995-1999, 2000-2004, and 2005-2011 (Jackson et al. 2014).

Overall, frequency of occurrence decreased from the 1980s to 2000, stabilizing in the first decade of 2000. There are locations such as the U.S. Virgin Islands where populations of elkhorn coral appear stable or possibly increasing in abundance and some such as the Florida Keys where population numbers are decreasing. In some cases when size class distribution is not reported, there is uncertainty of whether increases in abundance indicate growing populations or fragmentation of larger size classes into more small-sized colonies. From locations where size class distribution is reported, there is evidence of recruitment, but not the proportions of sexual versus asexual recruits. Events like hurricanes continue to heavily impact local populations and affect projections of persistence at local scales. We conclude there has been a significant decline of elkhorn coral throughout its range as evidenced by the decreased frequency of occurrence and that population abundance is likely to decrease in the future with increasing threats.

5.2.7.4 Threats

A summary of threats to all corals is provided in Section 5.2.2 General Threats Faced by All Coral Species. Detailed information on the threats to elkhorn coral can be found in the Final Listing rule (79 FR 53851; September 10, 2014); however, a brief summary is provided here. Elkhorn coral is highly susceptible to ocean warming, disease, ocean acidification, sedimentation, and nutrients, and susceptible to trophic effects of fishing, depensatory population effects from rapid, drastic declines and low sexual recruitment, and anthropogenic and natural abrasion and breakage.

Elkhorn coral is highly susceptible to disease as evidenced by the mass-mortality event in the 1970s and 1980s. White pox seems to be more common today than white band disease. The effects of disease are spatially and temporally (both seasonally and inter-annually) variable. Results from longer-term monitoring studies in the U.S. Virgin Islands and the Florida Keys indicate that disease can be a major cause of both partial and total colony mortality.

Elkhorn coral is highly susceptible to ocean warming. High water temperatures affect elkhorn coral through bleaching, lowered resistance to disease, and effects on reproduction. Temperature-induced bleaching and mortality following bleaching are temporally and spatially variable. Bleaching associated with the high temperatures in 2005 had a large impact on elkhorn coral with 40 to 50 % of bleached colonies suffering either partial or complete mortality in several locations. Algal symbionts did not shift in elkhorn coral after the 1998 bleaching event indicating the ability to adapt to rising temperatures may not occur through this mechanism. However, elkhorn coral showed evidence of resistance to bleaching from warmer temperatures in some portions of its range under some circumstances (Little Cayman). Through the effects on reproduction, high temperatures can potentially decrease larval supply and settlement success, decrease average larval dispersal distances, and cause earlier larval settlement affecting gene flow among populations.

Elkhorn coral is susceptible to acidification through reduced growth, calcification, and skeletal density. The effects of increased carbon dioxide combined with increased nutrients appear to be much worse than either stressor alone.

There are few studies of the effects of nutrients on elkhorn coral. Field experiments indicate that the mean net rate of uptake of nitrate by elkhorn coral exceeds that of ammonium by a factor of two and that elkhorn coral does not uptake nitrite (Bythell 1990). In Vega Baja, Puerto Rico, elkhorn coral mortality increased to 52% concurrent with pollution and sedimentation associated with raw sewage and beach nourishment, respectively, between December 2008 and June 2009 (Hernandez-Delgado et al. 2011b). Mortality presented as patchy necrosis-like and white pox-like conditions that impacted local reefs following anthropogenic disturbances and was higher inside the shallow platform (52-69%) and closer to the source of pollution (81-97%) compared to the outer reef (34 to 37 percent; Hernandez-Delgado et al. 2011b). Elkhorn coral is sensitive to nutrients as evidenced by increased mortality after exposure to raw sewage. Elkhorn coral is highly susceptible to nutrient enrichment. Elkhorn coral is also sensitive to sedimentation due to its poor capability of removing sediment and its high reliance on clear water for nutrition. Sedimentation can also cause tissue mortality.

Predators can have an impact on elkhorn coral both through tissue removal and the potential to spread disease. Predation pressure is spatially variable and almost non-existent in some locations. However, the effects of predation can become more severe if colonies decrease in abundance and density, as predators focus on the remaining living colonies.

5.2.7.5 Summary of Status

The species has undergone substantial population decline and decreases in the extent of occurrence throughout its range due mostly to disease. There is evidence of synergistic effects of threats for this species including disease outbreaks following bleaching events. Elkhorn coral is highly susceptible to a number of threats, and cumulative effects of multiple threats are likely to exacerbate vulnerability to extinction. Despite the large number of islands and environments that are included in the species' range, geographic distribution in the highly disturbed Caribbean exacerbates vulnerability to extinction over the foreseeable future because elkhorn coral is limited to an area with high localized human impacts and predicted increasing threats. Elkhorn coral occurs in turbulent water on the back reef, fore reef, reef crest, and spur and groove zone in water ranging from 1 to 30 m in depth. This moderates vulnerability to extinction over the foreseeable future because the species occurs in numerous types of reef environments that will, on local and regional scales, experience highly variable thermal regimes and ocean chemistry at any given point in time. Elkhorn coral has low sexual recruitment rates, which exacerbates vulnerability to extinction due to decreased ability to recover from mortality events when all colonies at a site are extirpated. In contrast, its fast growth rates and propensity for formation of clones through asexual fragmentation enables it to expand between rare events of sexual recruitment and increases its potential for local recovery from mortality events, thus moderating vulnerability to extinction. Its abundance and life history characteristics, combined with spatial variability in ocean warming and acidification across the species' range, moderate vulnerability to extinction because the threats are non-uniform. Subsequently, there will likely be a large number of colonies that are either not exposed or do not negatively respond to a threat at any given point in time. We anticipate that the population abundance is likely to decrease in the future with increasing threats.

5.2.8 Status of Staghorn Coral

Staghorn coral was listed as threatened under the ESA in May 2006 (71 FR 26852). In December 2012, NMFS proposed changing its status from threatened to endangered (77 FR 73219). On September 10, 2014, NMFS determined that staghorn coral should remain listed as threatened (79 FR 53851).

5.2.8.1 Species Description and Distribution

Staghorn coral is characterized by antler-like colonies with straight or slightly curved, cylindrical branches. The diameter of branches ranges from 0.1-2 in (0.25-5 cm; Lirman et al. 2010), and linear branch growth rates have been reported to range between 1.2-4.5 in (3-11.5 cm) per year (*Acropora* Biological Review Team 2005). The species can exist as isolated branches, individual colonies up to about 5 ft (1.5 m) diameter, and thickets comprised of multiple colonies that are difficult to distinguish from one another (*Acropora* Biological Review Team 2005).

Staghorn coral is distributed throughout the Caribbean Sea, in the southwestern Gulf of Mexico, and in the western Atlantic Ocean. The fossil record indicates that during the Holocene epoch, staghorn coral was present as far north as Palm Beach County in southeast Florida (Lighty et al. 1978), which is also the northern extent of its current distribution (Goldberg 1973).

Staghorn coral commonly occurs in water ranging from 16 to 65 ft (5 to 20 m) in depth, though it occurs in depths of 16-30 m at the northern extent of its range, and has been rarely found to 60 m in depth. Staghorn coral naturally occurs on spur and groove, bank reef, patch reef, and transitional reef habitats, as well as on limestone ridges, terraces, and hard bottom habitats (Cairns 1982; Davis 1982; Gilmore and Hall 1976; Goldberg 1973; Jaap 1984; Miller et al. 2008; Wheaton and Jaap 1988). Historically it grew in thickets in water ranging from approximately 16-65 ft (5-20 m) in depth; though it has rarely been found to approximately 195 ft (60 m; Davis 1982; Jaap 1984; Jaap et al. 1989; Schuhmacher and Zibrowius 1985; Wheaton and Jaap 1988). At the northern extent of its range, it grows in deeper water (~53-99 ft [16-30 m]; Goldberg 1973). Historically, staghorn coral was one of the primary constructors of mid-depth (approximately 33-50 ft [10-15 m]) reef terraces in the western Caribbean, including Jamaica, the Cayman Islands, Belize, and some reefs along the eastern Yucatan peninsula (Adey 1978). In the Florida Keys, staghorn coral occurs in various habitats but is most prevalent on patch reefs as opposed to their former abundance in deeper fore-reef habitats (i.e., 16-65 ft; Miller et al. 2008). There is no evidence of range constriction, though loss of staghorn coral at the reef level has occurred (*Acropora* Biological Review Team 2005).

Precht and Aronson (2004) suggest that coincident with climate warming, staghorn coral only recently re-occupied its historic range after contracting to south of Miami, Florida, during the late Holocene. They based this idea on the presence of large thickets off Ft. Lauderdale, Florida, which were discovered in 1998 and had not been reported in the 1970s or 1980s (Precht and Aronson 2004). However, because the presence of sparse staghorn coral colonies in Palm Beach County, north of Ft. Lauderdale, was reported in the early 1970s (though no thicket formation was reported; Goldberg 1973), there is uncertainty associated with whether these thickets were present prior to their discovery or if they recently appeared coincident with warming. The proportion of reefs with staghorn coral present decreased dramatically after the Caribbean-wide mass mortality in the 1970s and 1980s, indicating the spatial structure of the species has been affected by extirpation from many localized areas throughout its range (Jackson et al. 2014).

5.2.8.2 Life History Information

Relative to other corals, staghorn coral has a high growth rate that have allowed acroporid reef growth to keep pace with past changes in sea level (Fairbanks 1989). Growth rates, measured as skeletal extension of the end of branches, range from approximately 2-4 in (4-11 cm) per year (*Acropora* Biological Review Team 2005). Annual linear extension has been found to be dependent on the size of the colony. New recruits and juveniles typically grow at slower rates. Stressed colonies and fragments may also exhibit slower growth.

Staghorn coral is a hermaphroditic broadcast spawning species[9]. The spawning season occurs several nights after the full moon in July, August, or September depending on location and timing of the full moon, and may be split over the course of more than one lunar cycle (Szmant 1986; Vargas-Angel et al. 2006). The estimated size at sexual maturity is approximately 6 in (17 cm) branch length, and large colonies produce proportionally more gametes than small colonies (Soong and Lang 1992). Basal and branch tip tissue is not fertile (Soong and Lang 1992). Sexual recruitment rates are low, and this species is generally not observed in coral settlement studies. Laboratory studies have found that the presence of certain species of crustose-coralline algae facilitate larval settlement and post-settlement survival (Ritson-Williams et al. 2010).

Reproduction occurs primarily through asexual fragmentation that produces multiple colonies that are genetically identical (Tunnicliffe 1981). The combination of branching morphology, asexual fragmentation, and fast growth rates relative to other corals, can lead to persistence of large areas dominated by staghorn coral. The combination of rapid skeletal growth rates and frequent asexual reproduction by fragmentation can enable effective competition and can facilitate potential recovery from disturbances when environmental conditions permit. However, low sexual reproduction can lead to reduced genetic diversity and limits the capacity to repopulate spatially dispersed sites.

5.2.8.3 Status and Population Dynamics

Information on staghorn coral status and populations dynamics is infrequently documented throughout its range. Comprehensive and systematic census and monitoring has not been

[9] Simultaneously containing both sperm and eggs, which are released into the water column for fertilization.

conducted. Thus, the status and populations dynamics must be inferred from the few locations where data exist.

Vollmer and Palumbi (2007) examined 22 populations of staghorn coral from 9 regions in the Caribbean (Panama, Belize, Mexico, Florida, Bahamas, Turks and Caicos, Jamaica, Puerto Rico, and Curaçao) and concluded that populations greater than approximately 310 miles (500 km) apart are genetically different from each other with low gene flow across the greater Caribbean. Fine-scale genetic differences have been detected at reefs separated by as little as 1.25 miles (2 km), suggesting that gene flow in staghorn coral may not occur at much smaller spatial scales (Garcia Reyes and Schizas 2010; Vollmer and Palumbi 2007). This fine-scale population structure was greater when considering genes of elkhorn coral were found in staghorn coral due to back-crossing of the hybrid *A. prolifera* with staghorn coral (Garcia Reyes and Schizas 2010; Vollmer and Palumbi 2007). Populations in Florida and Honduras are genetically distinct from each other and other populations in the U.S. Virgin Islands, Puerto Rico, Bahamas, and Navassa (Baums et al. 2010), indicating little to no larval connectivity overall. However, some potential connectivity between the U.S. Virgin Islands and Puerto Rico was detected and also between Navassa and the Bahamas (Baums et al. 2010).

Staghorn coral historically was one of the dominant species on most Caribbean reefs, forming large, single-species thickets and giving rise to the nominal distinct zone in classical descriptions of Caribbean reef morphology (Goreau 1959). Massive, Caribbean-wide mortality, apparently primarily from white band disease (Aronson and Precht 2001), spread throughout the Caribbean in the mid-1970s to mid-1980s and precipitated widespread and radical changes in reef community structure (Brainard et al. 2011a). In addition, continuing coral mortality from periodic acute events such as hurricanes, disease outbreaks, and mass bleaching events has added to the decline of staghorn coral (Brainard et al. 2011a). In locations where quantitative data are available (Florida, Jamaica, U.S. Virgin Islands, Belize), there was a reduction of approximately 92 to greater than 97% between the 1970s and early 2000s (*Acropora* Biological Review Team 2005).

Since the 2006 listing of staghorn coral as threatened, continued population declines have occurred in some locations with certain populations of both listed *Acropora* species decreasing up to an additional 50% or more (Colella et al. 2012; Lundgren and Hillis-Starr 2008; Muller et al. 2008; Rogers and Muller 2012; Williams et al. 2008). Some small pockets of remnant robust populations have been reported in southeast Florida (Vargas-Angel et al. 2003), Honduras (Keck et al. 2005; Riegl et al. 2009), and Dominican Republic (Lirman et al. 2010). Additionally, Lidz and Zawada (2013) observed 400 colonies of staghorn coral along 44 mi (70.2 km) of transects near Pulaski Shoal in the Dry Tortugas where the species had not been seen since the cold water die-off of the 1970s.

Riegl et al. (2009) monitored staghorn coral in photo plots on the fringing reef near Roatan, Honduras from 1996 to 2005. Staghorn coral cover declined from 0.42% in 1996 to 0.14% in 1999 after the Caribbean bleaching event in 1998 and mortality from run-off associated with a Category 5 hurricane. Staghorn coral cover further declined to 0.09% in 2005. Staghorn coral colony frequency decreased 71% between 1997 and 1999. In sharp contrast, offshore bank reefs near Roatan had dense thickets of staghorn coral with 31% cover in photo-quadrats in 2005 and appeared to survive the 1998 bleaching event and hurricane, most likely due to bathymetric separation from land and greater flushing. Modeling showed that under undisturbed conditions, retention of the dense staghorn coral stands on the banks off Roatan is likely with a possible increased shift towards dominance by other coral species. However, the authors note that because their data and the literature seem to point to extrinsic factors as driving the decline of staghorn coral, it is unclear what the future may hold for this dense population (Riegl et al. 2009).

Other studies of population dynamics show mixed trends. While cover of staghorn coral increased from 0.6% in 1995 to 10.5% in 2004 (Idjadi et al. 2006) and 44% in 2005 on a Jamaican reef, it collapsed after the 2005 bleaching event and subsequent disease to less than 0.5% in 2006 (Quinn and Kojis 2008). A cold water die-off across the lower to upper Florida Keys in January 2010 resulted in the complete mortality of all staghorn coral colonies at 45 of the 74 reefs surveyed (61%) (Schopmeyer et al. 2012). Walker et al. (2012) report increasing size of 2 thickets (expansion of up to 7.5 times the original size of one of the thickets) monitored off southeast Florida, but also noted that cover within monitored plots concurrently decreased by about 50%, highlighting the dynamic nature of staghorn coral distribution via fragmentation and re-attachment.

A report on the status and trends of Caribbean corals over the last century indicates that the percentage of reefs with staghorn coral present has decreased over time. The frequency of reefs at which staghorn coral was described as the dominant coral has remained stable. The number of reefs with staghorn coral present declined during the 1980s from approximately 50 to 30% of reefs and remained relatively stable at 30% through the 1990s. The number of reefs with staghorn coral present decreased to approximately 20% in 2000-2004 and approximately 10% in 2005-2011 (Jackson et al. 2014).

There is some density data available for reefs in US jurisdiction. In Florida, staghorn coral was detected at 3% to 15% of the sites surveyed between 1999 and 2017. Average density ranged from 0.001 to 0.17 colonies per m^2. Staghorn coral was encountered less frequently during benthic surveys in the US Virgin Islands from 2002 to 2017. It was typically observed at $< 3\%$ of surveyed reefs with the highest frequency of observance at 18% in 2012. Density ranged from <0.001 to 0.07 colonies per m^2 (NOAA, unpublished data).

Benthic surveys between 2008 and 2018 in Puerto Rico detected an average density of 0.001 to 0.17 colonies per m^2, and colonies were observed at 4% to 25% of the reefs surveyed (NOAA, unpublished data). Staghorn coral was observed in 21 out of 301 stations between 2011 and 2013 in stratified random surveys designed to detect *Acropora* colonies along the south, southeast, southwest, and west coasts of Puerto Rico (García Sais et al. 2013). Staghorn coral was also observed at 16 sites outside of the surveyed area. The largest colony was 24 in (60 cm) and density ranged from 1-10 colonies per 162 ft^2 (15 m^2; García Sais et al. 2013).

Hurricanes Irma and Maria caused substantial damage in Florida, Puerto Rico, and the US Virgin Islands in 2017. Hurricane impacts included large, overturned and dislodged coral heads and extensive burial and breakage. At 153 survey locations in Puerto Rico, approximately 38% to 54% of staghorn corals were impacted (NOAA 2018). In a post-hurricane survey of 57 sites in

Florida, all of the staghorn coral colonies encountered were damaged by the hurricane (Florida Fish and Wildlife Conservation Commission, unpublished data). Survey data are not available for the US Virgin Islands, though qualitative observations indicate that damage was also widespread but variable by site.

Overall, populations appear to consist mostly of isolated colonies or small groups of colonies compared to the vast thickets once prominent throughout its range. Thickets are a prominent feature at only a few known locations. Across the Caribbean, frequency of occurrence has decreased since the 1980s. There are examples of increasing trends in some locations (Dry Tortugas and southeast Florida), but not over larger spatial scales or longer time frames. Population model projections from Honduras at one of the only known remaining thickets indicate the retention of this dense stand under undisturbed conditions. If refuge populations are able to persist, it is unclear whether they will be able to repopulate nearby reefs as observed sexual recruitment is low. Thus, we conclude that the species has undergone substantial population decline and decreases in the extent of occurrence throughout its range. We anticipate that population abundance is likely to decrease in the future with increasing threats.

5.2.8.4 Threats

A summary of threats to all corals is provided in Section 5.2.2 General Threats Faced by All Coral Species. Detailed information on the threats to staghorn coral can be found in the Final Listing rule (79 FR 53851; September 10, 2014); however, a brief summary is provided here. Staghorn coral is highly susceptible to ocean warming, disease, ocean acidification, sedimentation, and nutrients, as well as susceptible to trophic effects of fishing, depensatory population effects from rapid, drastic declines and low sexual recruitment, and anthropogenic and natural abrasion and breakage.

Staghorn coral is highly susceptible to disease as evidenced by the mass-mortality event in the 1970s and 1980s. Although disease is both spatially and temporally variable, about 5-6% of staghorn coral colonies appear to be affected by disease at any one time, though incidence of disease has been reported to range from 0-32% and up to 72% during an outbreak. There is indication that some colonies may be resistant to white band disease. Staghorn coral is also susceptible to several other diseases including one that causes rapid tissue loss from multiple lesions (e.g., Rapid Wasting Disease, White Patch Disease). Because few studies track diseased colonies over time, determining the present-day colony and population level effects of disease is difficult. One study that monitored individual colonies during an outbreak found that disease can be a major cause of both partial and total colony mortality (Williams and Miller 2005).

Staghorn coral is highly susceptible to bleaching in comparison to other coral species, and mortality after bleaching events is variable. Algal symbionts did not shift in staghorn coral after the 1998 bleaching event, indicating the ability of this species to acclimatize to rising temperatures may not occur through this mechanism. Data from Puerto Rico and Jamaica following the 2005 Caribbean bleaching event indicate that temperature anomalies can have a large impact on total and partial mortality and reproductive output.

Staghorn coral is highly susceptible to acidification through reduced growth, calcification, and skeletal density. The effects of increased carbon dioxide combined with increased nutrients appear to be synergistically worse and caused 100% mortality in some combination in one laboratory study.

Staghorn coral has high susceptibility to sedimentation through its sensitivity to turbidity (reduced light results in lower photosynthesis by symbiotic algae, so there is less food for the coral), and increased run-off from land clearing has resulted in mortality of this species through smothering. In addition, laboratory studies indicate the combination of sedimentation and nutrient enrichment appears to be synergistically worse.

Staghorn coral is also highly susceptible to elevated nutrients, which can cause decreased growth in staghorn coral. The combined effects of nutrients with other stressors such as elevated carbon dioxide and sedimentation appear to be worse than the effects of nutrients alone, and can cause colony mortality in some combinations.

Predators can have a negative impact on staghorn coral through both tissue removal and the spread of disease. Predation pressure appears spatially variable. Removal of tissue from growing branch tips of staghorn coral may negatively affect colony growth, but the impact is unknown, as most studies do not report on the same colonies through time, inhibiting evaluation of the longer-term impact of these predators on individual colonies and populations.

5.2.8.5 Summary of Status

The species has undergone substantial population decline and decreases in the extent of occurrence throughout its range due mostly to disease. There is evidence of synergistic effects of threats for this species where the effects of increased nutrients are combined with acidification and sedimentation. Staghorn coral is highly susceptible to a number of threats, and cumulative effects of multiple threats are likely to exacerbate vulnerability to extinction. Despite the large number of islands and environments that are included in the species' range, geographic distribution in the highly disturbed Caribbean exacerbates vulnerability to extinction over the foreseeable future because staghorn coral is limited to areas with high, localized human impacts and predicted increasing threats. Staghorn coral commonly occurs in water ranging from 5 to 20 m in depth, though it occurs in depths of 16-30 m at the northern extent of its range, and has been rarely found to 60 m in depth. It occurs in spur and groove, bank reef, patch reef, and transitional reef habitats, as well as on limestone ridges, terraces, and hard bottom habitats. This habitat heterogeneity moderates vulnerability to extinction over the foreseeable future because the species occurs in numerous types of reef and hard bottom environments that are predicted, on local and regional scales, to experience highly variable thermal regimes and ocean chemistry at any given point in time. Staghorn coral has low sexual recruitment rates, which exacerbates vulnerability to extinction due to decreased ability to recover from mortality events when all colonies at a site are extirpated. In contrast, its fast growth rates and propensity for formation of clones through asexual fragmentation enables it to expand between rare events of sexual recruitment and increases its potential for local recovery from mortality events, thus moderating vulnerability to extinction. Its abundance and life history characteristics, combined with spatial variability in ocean warming and acidification across the species' range, moderate the species' vulnerability to extinction because the threats are non-uniform. Subsequently, there will likely be a large number of colonies that are either not exposed or do not negatively respond to a threat at any given point in time. However, we also anticipate that the population abundance is likely to decrease in the future with increasing threats.

5.3 Elkhorn and Staghorn Coral Critical Habitat

On November 26, 2008, a Final Rule designating *Acropora* critical habitat was published in the Federal Register (73 FR 72210). Within the geographical area occupied by a listed species, critical habitat consists of specific areas on which are found those physical or biological features essential to the conservation of the species. The feature essential to the conservation of *Acropora* species (also known as the essential feature) is substrate of suitable quality and availability in water depths from the mean high water line to 30 m in order to support successful larval settlement, recruitment, and reattachment of fragments. "Substrate of suitable quality and availability" means consolidated hard bottom or dead coral skeletons free from fleshy macroalgae or turf algae and sediment cover. Areas containing this feature have been identified in 4 locations within the jurisdiction of the United States: the Florida area, which comprises approximately 1,329 mi^2 (3,442 km^2) of marine habitat; the Puerto Rico area, which comprises approximately 1,383 mi^2 (3,582 km^2) of marine habitat; the St. John/St. Thomas area, which comprises approximately 121 mi^2 (313 km^2) of marine habitat; and the St. Croix area, which comprises approximately 126 mi^2 (326 km^2) of marine habitat. The total area covered by the designation is thus approximately 2,959 mi^2 (7,664 km^2).

The essential feature can be found unevenly dispersed throughout the critical habitat units, interspersed with natural areas of loose sediment, fleshy or turf macroalgae covered hard substrate. Existing federally authorized or permitted man-made structures such as artificial reefs, boat ramps, docks, pilings, channels or marinas do not provide the essential feature. The proximity of this habitat to coastal areas subjects this feature to impacts from multiple activities including dredging and disposal activities, stormwater run-off, coastal and maritime construction, land development, wastewater and sewage outflow discharges, point and non-point source pollutant discharges, fishing, placement of large vessel anchorages, and installation of submerged pipelines or cables. The impacts from these activities, combined with those from natural factors (i.e., major storm events), significantly affect the quality and quantity of available substrate for these threatened species to successfully sexually and asexually reproduce.

A shift in benthic community structure from coral-dominated to algae-dominated that has been documented since the 1980s means that the settlement of larvae or attachment of fragments is often unsuccessful (Hughes and Connell 1999). Sediment accumulation on suitable substrate also impedes sexual and asexual reproductive success by preempting available substrate and smothering coral recruits.

While algae, including crustose coralline algae and fleshy macroalgae, are natural components of healthy reef ecosystems, increases in the dominance of algae since the 1980s impedes coral recruitment. The overexploitation of grazers through fishing has also contributed fleshy macroalgae to persist in reef and hard bottom areas formerly dominated by corals. Impacts to water quality associated with coastal development, in particular nutrient inputs, are also thought to enhance the growth of fleshy macroalgae by providing them with nutrient sources. Fleshy macroalgae are able to colonize dead coral skeleton and other hard substrate and some are able to overgrow living corals and crustose coralline algae. Because crustose coralline algae is thought to provide chemical cues to coral larvae indicating an area is appropriate for settlement, overgrowth by macroalgae may affect coral recruitment (Steneck 1986). Several studies show that coral recruitment tends to be greater when algal biomass is low (Birrell et al. 2005; Connell et al. 1997; Edmunds et al. 2004; Hughes 1985; Rogers et al. 1984; Vermeij 2006). In addition to preempting space for coral larval settlement, many fleshy macroalgae produce secondary metabolites with generalized toxicity, which also may inhibit settlement of coral larvae (Kuffner and Paul 2004). The rate of sediment input from natural and anthropogenic sources can affect reef distribution, structure, growth, and recruitment. Sediments can accumulate on dead and living corals and exposed hard bottom, thus reducing the available substrate for larval settlement and fragment attachment.

In addition to the amount of sedimentation, the source of sediments can affect coral growth. In a study of 3 sites in Puerto Rico, Torres (2001) found that low-density coral skeleton growth was correlated with increased re-suspended sediment rates and greater percentage composition of terrigenous sediment. In sites with higher carbonate percentages and corresponding low percentages of terrigenous sediments, growth rates were higher. This suggests that re-suspension of sediments and sediment production within the reef environment does not necessarily have a negative impact on coral growth while sediments from terrestrial sources increase the probability that coral growth will decrease, possibly because terrigenous sediments do not contain minerals that corals need to grow (Torres 2001).

Long-term monitoring of sites in the USVI indicate that coral cover has declined dramatically; coral diseases have become more numerous and prevalent; macroalgal cover has increased; fish of some species are smaller, less numerous, or rare; long-spined black sea urchins are not abundant; and sedimentation rates in nearshore waters have increased from one to 2 orders of magnitude over the past 15 to 25 years (Rogers et al. 2008). Thus, changes that have affected elkhorn and staghorn coral and led to significant decreases in the numbers and cover of these species have also affected the suitability and availability of habitat.

Elkhorn and staghorn corals require hard, consolidated substrate, including attached, dead coral skeleton, devoid of turf or fleshy macroalgae for their larvae to settle. Atlantic and Gulf of Mexico Rapid Reef Assessment Program data from 1997-2004 indicate that although the historic range of both species remains intact, the number and size of colonies and percent cover by both species has declined dramatically in comparison to historic levels (Ginsburg and Lang 2003). Monitoring data from the USVI TCRMP indicate that the 2005 coral bleaching event caused the largest documented loss of coral in USVI since coral monitoring data have been available with a decline of at least 50% of coral cover in waters less than 25 m deep (Smith et al. 2011). Many of the shallow water coral monitoring stations showed at most a 12% recovery of coral cover by 2011, 6 years after the loss of coral cover due to the bleaching event (Smith et al. 2011). The lack of coral cover has led to increases in algal cover on area hard bottom, including the critical habitat essential feature.

5.3.1 St. Croix Unit

The St. Croix marine unit, which includes the action area for the proposed project, comprises approximately 126 mi^2 (mi^2) or 80,640 ac of ESA-designated elkhorn and staghorn coral critical habitat (Figure 18). Of this area, approximately 57,600 ac (90 mi^2), or 71%, are likely to contain the essential features of ESA-designated acroporid coral critical habitat, based on the amount of coral, rock reef, colonized hard bottom, and other coralline communities mapped by NOS's Biogeography Program in 2000 (Kendall et al. 2001). The other areas within the St. Croix marine unit are dominated by sand and unconsolidated bottom, seagrass beds with varying densities of coverage, and uncolonized hard bottoms (Kendall et al. 2001). Of the 57,600-ac area in the St. Croix unit, approximately 7,117.7 ac (11.12 mi^2) are within the 0-5 m depth range that is particularly important to elkhorn corals. It should be noted that elkhorn corals can be found in deeper water (up to 30 m in backreef environments) but maximum depth of framework construction ranges from 3 to 12 m, and colonies generally do not form thickets below a depth of 5 m (Lighty et al. 1982).

Elkhorn and staghorn corals require hard, consolidated substrate, including attached, dead coral skeleton, devoid of turf or fleshy macroalgae for their larvae to settle. Atlantic and Gulf of Mexico Rapid Reef Assessment Program data from 1997-2004 indicate that although the historic range of both species remains intact, the number and size of colonies and percent cover by both species has declined dramatically in comparison to historic levels (Ginsburg and Lang 2003). Monitoring data from the USVI Territorial Coral Reef Monitoring Program indicate that the 2005 coral bleaching event caused the largest documented loss of coral in USVI since coral monitoring data have been available with a decline of at least 50% of coral cover in waters less than 25 m deep (Smith et al. 2011). Many of the shallow water coral monitoring stations, including areas with elkhorn corals, showed at most a 12% recovery of coral cover by 2011, 6 years after the loss of coral cover due
to the bleaching event (Smith et al. 2011). Lack of coral cover has led to increases in algal cover on area hard bottom.

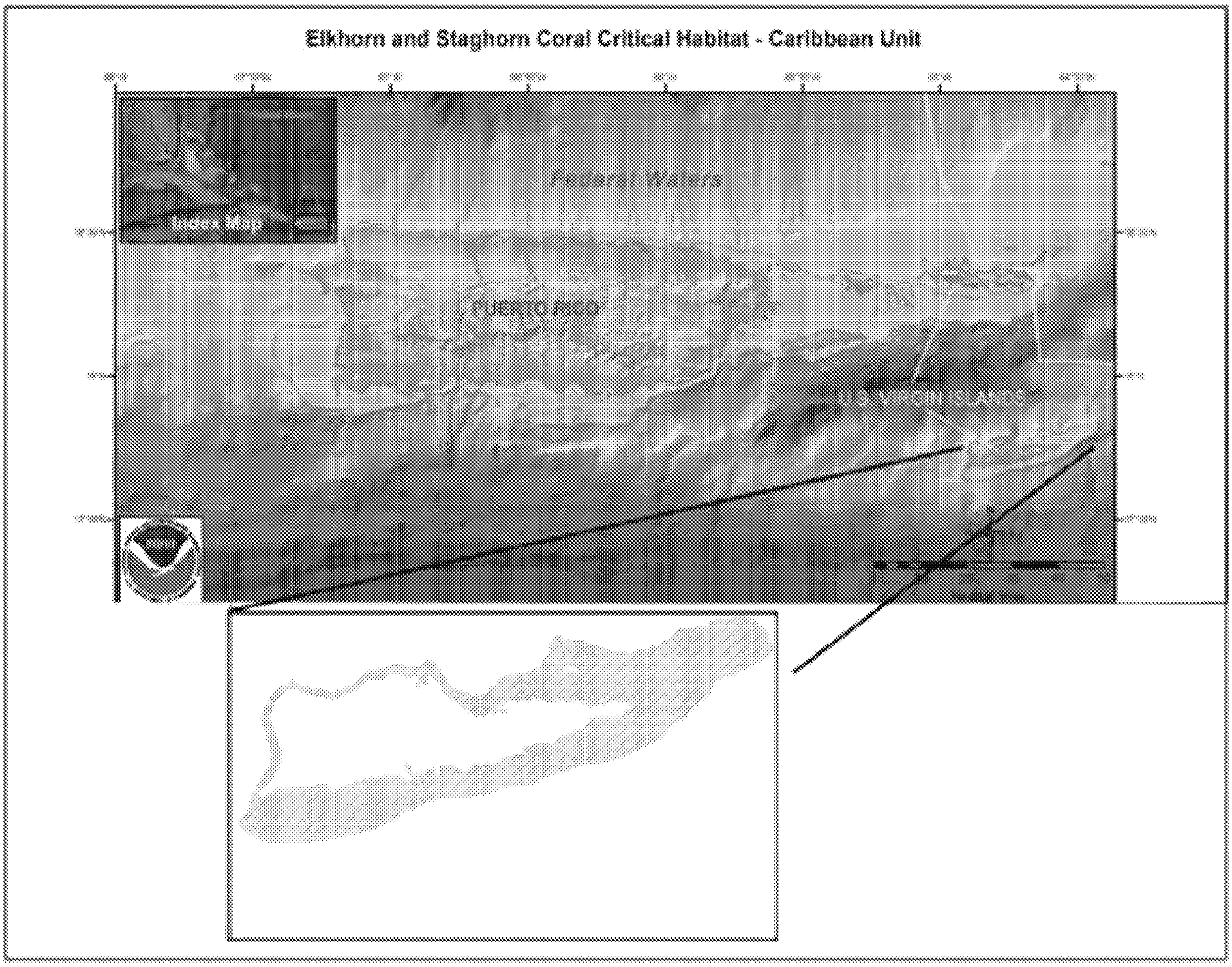

Figure 18. Critical habitat map, with inset of St. Croix unit, for elkhorn and staghorn corals (Acropora Critical Habitat map created by NMFS, 2008; see http://sero.nmfs.noaa.gov/maps_gis_data/protected_resources/critical_habitat/index.html)

Long-term monitoring of sites in USVI indicates that coral cover has declined dramatically; coral diseases have become more numerous and prevalent; macroalgal cover has increased; fish of some species are smaller, less numerous, or rare; long-spined black sea urchins are not abundant; and sedimentation rates in nearshore waters have increased by 1-2 orders of magnitude over the past 15-25 years (Rogers et al. 2008). The monitoring program has also found evidence that land-based sources of pollutants are having negative impacts on nearshore coral reefs by blocking sunlight leading to decreases in photosynthesis and growth of corals, increasing the growth of organisms that compete with corals for space due to increasing nutrient concentrations, and smothering of corals and potential settlement habitat (Smith et al. 2011). Recent studies from the USVI have found that sediment levels as low as 3 mg per cm^2 per day can cause large increases in the proportion of corals experiencing impairment, partial mortality, and bleaching if sediment is terrigenous in nature (Smith et al. 2013). The majority of nearshore waters around USVI were found to have sediment rates of at least 10 mg per cm^2 per day indicating that the majority of nearshore hard bottoms and reefs around USVI are impacted by sedimentation (T. Smith et al. 2008). Changes that have affected elkhorn and staghorn corals and led to decreases in the numbers and cover of these species have also affected the essential feature of their critical habitat. Specifically, macroalgal cover has increased (Rogers et al. 2008) due, in part, to increases in nutrient concentrations (Smith et al. 2001) and sediment cover has increased (T. Smith et al. 2008). Therefore, we conclude that the essential feature of elkhorn and staghorn coral, which is consolidated hard bottom or dead coral skeletons free from fleshy macroalgae or turf algae and sediment cover, has been adversely affected by land-based sources of pollutants to nearshore waters around the USVI. The impacts have resulted in a fragmented patchwork of habitat containing the essential feature capable of supporting settlement of coral larvae, due to the distances between suitable hardbottom.

McLaughlin et al. (2002)found that when distributions of coral species become isolated because of habitat loss, populations become more vulnerable to climate change and other threats. The loss of habitat patches will affect the availability of areas for coral larvae to settle. Larvae are only viable for a short time so larger distances between areas of suitable habitat for elkhorn corals make settlement and growth less likely. Smith et al. (2014) concluded that the lack of colonization by elkhorn corals on the west and south coasts of St. Croix likely indicates prior losses of these corals due to disease, hurricanes, habitat degradation, and the limited availability of shallow hard bottom habitat, making the areas on the north west side of St. Croix (important for recovery of the species due to a relative lack of development in the area.

6 ENVIRONMENTAL BASELINE

This section identifies the effects of past and ongoing human and natural factors leading to the current status of the species, their habitat, and ecosystem, within the action area. The environmental baseline includes state, tribal, local, and private actions already affecting the species, or that will occur contemporaneously with the consultation in progress. Unrelated federal actions affecting the same species or critical habitat that have completed formal or informal consultation are also part of the environmental baseline, as are federal and other actions within the action area that may benefit listed species or critical habitat.

The environmental baseline for this Opinion includes several activities that affect the survival and recovery of ESA-listed corals and the ability of designated acroporid coral critical habitat in the action area to support its intended conservation function for staghorn and elkhorn corals. Hurricanes Irma and Maria passed through the Caribbean in September 2017. While St. Croix was relatively unaffected by Hurricane Irma, Hurricane Maria caused widespread damage to the island. Because the island is still recovering, assessments of in-water impacts to benthic habitats, including coral reefs that are part of the TCRMP have not been completed. Therefore, there is a possibility that the environmental baseline for ESA-listed corals and coral critical habitat around St. Croix has been degraded from the conditions described here due to impacts from the recent hurricanes.

6.1 ESA-Listed Corals and Acroporid Coral Critical Habitat within the Action Area

6.1.1 ESA-Listed Corals

The benthic studies conducted for this project note that there may be colonies of mountainous star corals within the potential area of impact that extends beyond the project footprint. Limetree reports that there are colonies of mountainous star, boulder star corals, elkhorn corals, pillar corals and rough cactus coral within the immediate action area. Staghorn and lobed star colonies are known to be within the expanded action area for fragment collection including the reefs surrounding St. Croix. The number of colonies for all coral species observed during the benthic surveys both to the east and west of the channel are reported in the Environmental Assessment Report dated July 2017, and while the applicant reports there are no mountainous star coral in the project footprint, they state there may be up to 8 in the potential impact area from which corals will be transplanted.

Because of the industrial nature of the area and the fact that the site is highly impacted and there are navigational restrictions enforced by the Coast Guard, very few studies have been completed with the project action area. The southwestern shore from Hess Oil to Sandy Point once contained relatively good reef development but the dredging of Krauss Lagoon and numerous ship channels have killed most of the nearshore and bank reefs (Goenaga and Boulon 1992).

According to the applicant, studies done by Tetra-Tech in 1973 in association with the Virgin Islands Port Authority's (VIPA)'s Third Port project reported the presence boulder star coral on the reefs to the west of the project site between the channels during surveys both deeper and shallower than 12m (Figure 19). Boulder star, lobed star and mountainous star corals have been reported by Bioimpact, Inc. during environmental studies for the Molasses Dock Expansion projects (Figure 19) and dredging projects on the reefs to the west (2013, 2017, 2009, 1993, 1986). Bioimpact, Inc., also reported lobed star corals on the revetment near the Coker Dock during the permitting of the dock, which allowed the refinery to make other refined products (2000) (Figure 19).

Figure 19. Previous Studies in the Action Area

6.1.2 Elkhorn and Staghorn Coral Critical Habitat

The feature of critical habitat essential to the conservation of elkhorn and staghorn corals is substrate of suitable quality and availability, in water depths of 30 m or less, to support successful recruitment and population growth. This includes areas of exposed hard substrate and dead coral skeleton free of sediment cover and turf and fleshy macroalgae cover. The St. Croix marine unit comprises approximately 126 mi^2 (80,640 ac). Of this area, approximately 90 mi^2 (57,600 ac), or 71%, are most likely to contain the essential physical feature of coral critical habitat, based on the amount of coral, rock reef, colonized hard bottom, and other coralline communities mapped by NOS in 2001. The other areas within the St. Croix marine unit are dominated by sand and unconsolidated bottom, seagrass beds with varying densities of coverage, and uncolonized hard bottoms based on the NOS benthic maps (Kendall et al. 2001).

According to the NOS benthic habitat maps, within the 4,000 ac that extends 3.5 km offshore identified by the USACE as the action area, there are approximately 590 ac of habitat containing the essential feature of substrate of potentially suitable quality and availability, in water depths of 30 m or less, to support successful recruitment and population growth. The area is subject to settling fine sediments and turbidity impacts due to the industrial nature of the port. The benthic surveys completed for the EAR covered 800 ac of area along 1,500 m of shoreline and extending 2,800 m offshore. The benthic surveys found 224 ac of colonized hard bottom habitat within the 800-ac survey area that was less than 30 m (approximately 1/3 of the survey area was deeper than 30 m (Figure 20). Elkhorn corals are most often found in water depths 5 m or less, but can occasionally be found in 30 m of water in back reef environments. Using the NOS benthic maps, the available essential feature in water depths 5 m or less is approximately 11.12 mi^2 (7,117.7 ac) in the St. Croix Unit. The action area contains approximately 50 ac of essential feature in depths of 5 m or less. It should be noted that the shallow reef crest between the Limetree Bay Channel and the Alucroix Channel to the east is primarily made up of elkhorn coral skeletons.

Staghorn corals are typically found in waters with depths greater than 5 m around St. Croix. Smith et al. (2014) found staghorn corals in waters from 6-18 m in depth, but noted that more colonies are likely present in deeper waters. Toller (2005) found staghorn corals in depths up to 35 m within the Frederiksted Reef System. Smith et al. (2014) found that the lack of colonization by elkhorn and staghorn corals on the west and south coasts of St. Croix is likely the result of limited availability of shallow hard bottom habitat in much of the area, as well as erosion of colonies and anthropogenic effects decades before monitoring.

Studies done in association with previous projects from as far back as 1973 report elkhorn coral in the action area, but no one has reported live staghorn within the action area, however staghorn coral skeletons have been found in the action area by the applicant's consultant (pers. Comm.) so at one time they did occur within the action area.

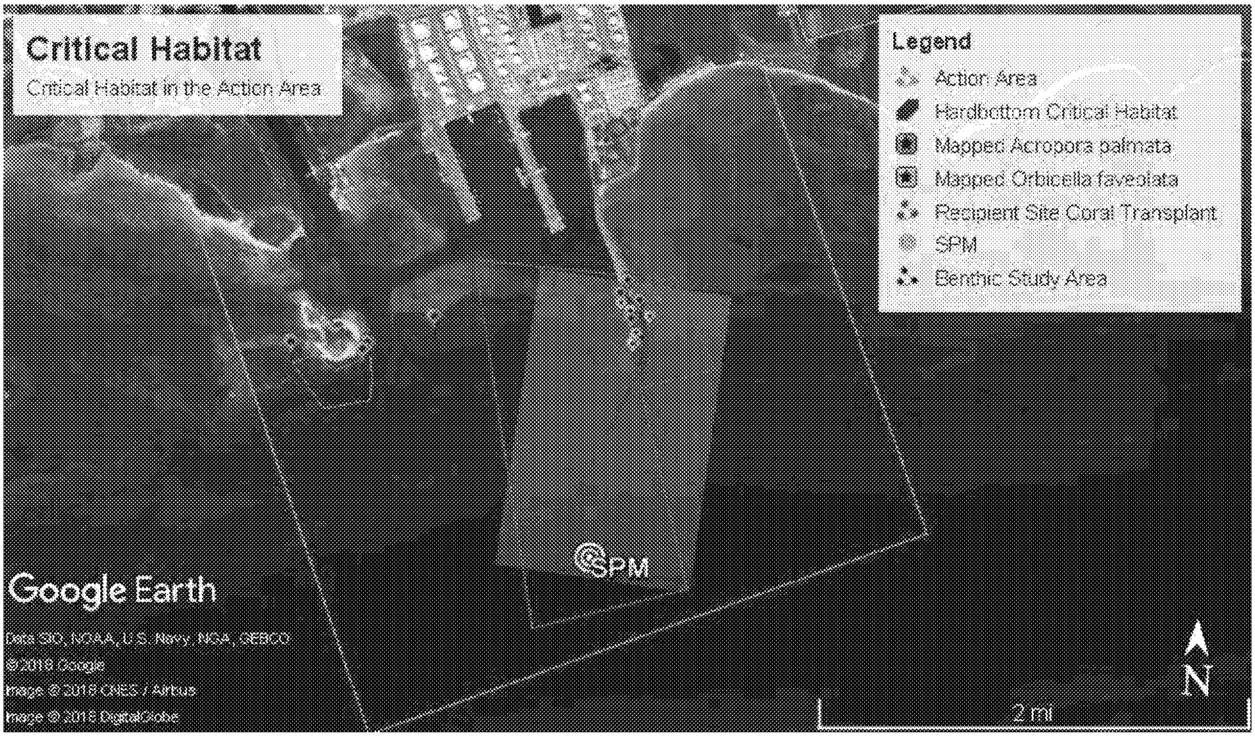

Figure 20. Critical Habitat as Indicated by the Red Polygons. The Blue Outline Represents the Benthic Study Area

6.2 Factors Affecting All ESA-Listed Corals and Coral Critical Habitat within the Action Area

Activities funded, authorized, or carried out by federal agencies, state agencies, and private entities have been identified as threats and may affect critical habitat for staghorn and elkhorn corals and colonies of mountainous star, boulder star, lobed star, staghorn, elkhorn, rough cactus and pillar corals in the action area. The activities that shape the environmental baseline in the action area of this consultation are fisheries, vessel operations, ESA Permitting, coastal development, and natural disturbances. Climate change is also likely to play an increasingly important role in determining the abundance of ESA-listed coral species and the conservation value of elkhorn and staghorn coral critical habitat around St. Croix. High thermal stress caused by climate change has been identified as the greatest threat to the coral reef ecosystems in the USVI (Smith et al. 2011). The 2005 mass bleaching event caused a 50% decline in coral cover, particularly of the dominant *Orbicella* species complex in waters less than 25 m deep, the largest documented loss of coral in USVI history (Smith et al. 2011). Recovery has been marginal at most sites since the 2005 bleaching event (Smith et al. 2011).

Although regulations exist to protect corals (see Sections 5.2.2 and 5.3, Final Rule), including ESA-listed corals, many of the activities identified as threats still adversely affect ESA-listed coral species and acroporid coral critical habitat. Poor boating and anchoring practices, poor snorkeling and diving techniques, and destructive fishing practices cause physical damage to habitat and ESA-listed coral colonies. Nutrients, contaminants, and sediment from point and non-point sources create an unfavorable environment for reproduction and growth of corals by promoting overgrowth of hard substrate by algae or the buildup of sediment layers that prohibit coral settlement. Boating and anchoring are currently not the most significant issue impacting the action area, due to navigational restrictions enforced by the Coast Guard in this industrialized area. The Coast Guard established a security zone in and around the refinery, which includes all waters from the surface to the bottom. Any vessels are required to obtain authorizations from the Coast Guard Captain of the Port of San Juan.

6.2.1 Fisheries

Several types of fishing gears used within the action area may adversely affect coral critical habitat and coral colonies. The low abundance of important fishery species around St. Croix was noted in the results of the TCRMP. This is also thought to be part of the reason reefs around St. Croix have not recovered following the 2005 bleaching event as the lack of herbivorous fish and invertebrates is thought to have contributed to the colonization of affected reef areas by an abundance of macroalgae and filamentous cyanobacteria, which limit coral regrowth and recruitment (Smith et al. 2011). Fishing pressure measured by the number of registered commercial fisherman versus shelf areas with less than 64 m depths is approximately 4 times greater on St. Croix than on St. Thomas/St. John, likely because St. Thomas/St. John has more deep shelf area, and shallow waters around St. Croix were found to have more intensive netting and spearfishing (Smith et al. 2011).

Longline, other types of hook-and-line gear, and traps have all been documented as interacting with coral habitat and coral colonies in general, though no data specific to ESA-listed corals and their habitat is available. Available information suggests hooks and lines can become entangled in reefs, resulting in breakage and abrasion of corals. Net fishing can also affect coral habitat and coral colonies if this gear drags across the marine bottom either due to efforts targeting reef and hard bottom areas or due to derelict gear. Studies by Sheridan et al. (2003) and Schärer et al. (2004) showed that most trap fishers do not target high-relief bottoms to set their traps due to potential damage to the traps. However, lost traps and illegal traps can affect corals and their habitat if they are moved onto reefs or colonized hard bottoms during storms or placed on coral habitat because the movement of the traps leads to breakage and abrasion of corals. Due to the above mentioned (section 6.2) security zone restrictions, derelict fishing gear only becomes an issue for the reefs when storm events move the gear into the area of the refinery. However, local fisherman tend to cut over and between the channels in their fishing boats in the shallows, which sometimes cause long gouges that are cut in the seagrass beds to the west of the site and prop damage was also noted on the shallow western reef. (Personal communication A. Dempsey, October 2018)

For all fisheries for which there is a fishery management plan (FMP) or for which any federal action is taken to manage that fishery, impacts are evaluated under Section 7 of the ESA. NMFS reinitiated Section 7 consultations for the Coral, Queen Conch, Reef Fish, and Spiny Lobster FMPs under the jurisdiction of the Caribbean Fishery Management Council (CFMC) when elkhorn and staghorn corals were listed and critical habitat was designated for these corals. NMFS concluded that the implementation of the Coral FMP will have no effect on ESA-listed corals or coral designated critical habitat. NMFS determined that the Queen Conch FMP is not likely to adversely affect elkhorn and staghorn corals or their designated critical habitat. NMFS determined the Reef Fish and Spiny Lobster FMPs will adversely affect but not jeopardize elkhorn and staghorn corals and will adversely affect but not destroy or modify their designated critical habitat. NMFS reinitiated consultation for the Spiny Lobster and Reef Fish FMPs on September 26, 2014 to consider the potential effects of these fisheries on pillar, rough cactus, lobed star, mountainous star, and boulder star corals. On January 19, 2016, NMFS and subsequently in a memo dated October 24, 2016, determined that allowing the continued authorization of fishing under the Spiny Lobster and Reef Fish FMPs was not likely to adversely affect pillar, rough cactus, lobed star, mountainous star, and boulder star corals.

6.2.2 Vessel Operations

Potential sources of adverse effects from federal vessel operations in the action area include operations of the USCG and NOAA. Through the Section 7 process, where applicable, NMFS will continue to establish conservation measures for agency vessel operations to avoid or minimize adverse effects to ESA-listed corals and acroporid coral critical habitat. At the present time, however, they present the potential for some level of interaction.

Commercial and recreational vessel traffic can adversely affect ESA-listed coral colonies and coral critical habitat through propeller scarring, propeller wash, and accidental groundings. Based on information from the NOAA Restoration Center (RC) and NOAA's ResponseLink, reports of accidental groundings are becoming more common in USVI and Puerto Rico, but numerous vessel groundings are likely not reported. There are no reports of vessel groundings in the project area. The project area has been subject to large volumes of commercial traffic since the 1960's. There are two primary channels on the south shore of St. Croix, Limetree Bay and Krause Lagoon. Between them there is a cross channel connecting the VIPA Container Port. Traffic to the three harbors, Port Renaissance, Container Port and Limetree Bay Terminals is controlled by the respective marine departments. There is mandatory pilotage and tug assist for all traffic. The VI Port Authority averages 30 vessels per month. Port Renaissance averages 2-3 vessels per month. Limetree Bay Terminals averages 30-40 vessels per month. In addition to the commercial traffic, there is a large number of private vessels trailered and launched at the Gordon Finch Dock area. These vessels pose the greatest risk of vessel grounding in the area. Through the Section 7 process for dock, port, and marine construction activities under the jurisdiction of the USACE, NMFS will continue to establish conservation measures to ensure that the construction and operation of these facilities avoids or minimizes adverse effects to ESA-listed species and critical habitat.

Limetree Bay Channel serves Limetree Bay terminals and the VIPA. The vessel traffic is in excess of 40 vessels per month. The largest vessel this channel can safely accommodate is a VLBC. These vessels are currently berthed inside the harbor and this requires a transit of the channel inbound and outbound. This project will reduce these transits by 30-40 per year, greatly decreasing the risk of groundings.

All ballast water discharged during loading is exchanged multiple times during the vessels voyage from her last port of call per international regulations.

6.2.3 ESA Permits

Section 10(a)(1)(A) of the ESA allows issuance of permits for take of certain ESA-listed species for the purposes of scientific research, and section 10(a)(1)(B) authorizes issuance of permits for take of listed species incidental to other activities under certain conditions. Section 10(a) (1) (A) permits are not required for research on ESA-listed corals, which are listed as threatened. NMFS promulgated a rule under section 4(d) of the ESA to prohibit most take of elkhorn and staghorn corals, but found that permits from VIDPNR in the USVI were sufficiently protective such that a Section 10 permit(a)(1)(A) was not required from NMFS for these species, but a 10(a)(1)(B) permit would still be required. The other 5 species of listed corals do not have a 4(d) rule, therefore no Section 9 prohibitions apply and no Section 10 permit for take of these species is required at this time.

6.2.4 Coastal Development

Anthropogenic sources of marine pollution, while difficult to attribute to a specific federal, state, local or private action, may indirectly affect coral colonies and coral critical habitat in the action area. Nutrient loading from land-based sources, such as coastal communities, are known to stimulate plankton blooms in closed or semi-closed estuarine systems and algal blooms in these areas, as well as in nearshore waters. As noted previously, water quality monitoring studies by DEP in waters around USVI indicate that surface waters are affected by increasing point and non-point source pollution from failing septic systems, discharges from vessels, failure of best management practices on construction sites, and failure of on-site disposal methods (Rothenberger et al. 2008). These factors result in increased sedimentation and nutrient transport, bacterial contamination, and trash and other debris entering surface and nearshore waters from developed areas. DEP reports that water quality around USVI continues to decline based on monitoring data from around USVI. This is indicated by the designation of 69 ac as impaired in 2006 versus 50 ac in 2005 (Rothenberger et al. 2008). The 2012 impaired waters list included 98 sites and the 2016 list includes 89 sites throughout USVI, indicating that water quality continues to decline throughout USVI. The 2016 impaired waters list includes 34 sites around St. Croix of which Limetree Bay Terminals (HOVENSA) is one. (https://www.epa.gov/sites/production/files/2017-02/.../2016_usvi_303d_list.pdf). The Limetree Bay Terminals (HOVENSA) site is listed as being in Category 1 - Watersheds in Need of Restoration "These watersheds do not currently meet, or face imminent threat of not meeting, clean water and other natural resource goals." The Limetree Bay Terminals watershed drains 7,642 ac including large areas of residential use with septic tanks. The bay is also subject to periodic sewage overflows from the VIWMA Figtree pump station immediately to the east of the site. Limetree Bay Terminals and St. Croix Renaissance are within the south part of St. Croix 14-Digit HUC and Watershed # 21020002020020. The waters include an area also monitored as a part of the Virgin Island Ambient Water Quality Monitoring Program sites STC 16, 17, and 18. The harbor waters are designated Class C. Class C waters are the lowest tier of water quality class in the USVI. The Limetree Bay Terminal Facility has a TPDES Permit VI0000019 for the discharge of stormwater, and process water including WWTP effluent and industrial processes. No TMDLs have been established for the area and the Virgin Islands considers the Limetree Bay Terminals area a low priority and do not foresee setting TMDLs before 2031. Twenty-eight percent of the used oil storage on St. Croix occurs within the Limetree Bay Terminals watershed. Limetree Bay Terminals Harbor (HOVENSA) is listed as an impaired water body for dissolved oxygen, enterococci, phosphorus, temperature, turbidity. Limetree Bay is also listed as an impaired water body for fecal coliform, and dissolved oxygen.

Increases in pollutant levels and sediment loading result in habitat degradation leading to the loss of suitable hardbottom habitat for coral settlement and growth due to increased algal growth and sedimentation, as has been reported for sites around USVI. A study of 3 sites in Puerto Rico showed that resuspension of marine sediments did not significantly affect coral growth but sedimentation by terrigenous sediments in reef areas had a negative effect on coral growth rates (Torres 2011). Specifically at Limetree, industrial operations, (including discharges and accidental spills), at the former oil refinery could have led to the release of contaminants in the nearby environment. Contaminants documented in marine and groundwater environments at the site include petroleum, methyl-tertiary-butyl ether, chromium, nickel, vanadium 2, lead, arsenic, and mercury (Holmes et al. 2012). More recently, according to Limetree Bay Terminals, LLC (starting in 2016), there have been five smaller spills that were reported to the US Coast Guard, of varying products ranging from less than 2 gallons up to 100 gallons, appropriate clean-ups and reporting were completed in all instances.

The development of the south shore industrial complex began with the dredging of the Harvey Alumina Channel in the early 1960's and the filling of the Krause Lagoon wetlands. The initial dredging was done by blasting through the reef and the suction dredging and deposition of fill into the wetland. At the time due to limited environmental regulations, no turbidity control was implemented. Over the next 14 years, dredging and filling projects will be undertaken in the area with the creation of the refinery and marine terminal, which is now Limetree Bay Terminals. Within the area, there are large accumulations of very fine sediment, which originated from dredging and blasting. When seas are rough or large vessels transit the channels and the harbor, they suspend these sediments and the entire inshore area beyond the shelf drop becomes extremely turbid and remains so for extended periods. The aerial shows turbidity and sedimentation plumes observed in the area (Figure 21).

Figure 21. SPM landing site as shown by the orange arrow. The green arrows point out the layers of turbidity and sedimentation plumes created by the southern swell. The plumes in the western turning basin maybe the result of ship activities. Note that plumes are present to the west well along the shoreline.

6.2.5 Natural Disturbance

Hurricanes and large coastal storms can also harm coral colonies and coral critical habitat. Historically, large storms potentially resulted in asexual reproductive events, if the fragments encountered suitable substrate, attached, and grew into new colonies. However, recently, the amount of suitable substrate has been significantly reduced; therefore, many fragments created by storms die. Hurricanes are also sometimes beneficial, if they do not result in heavy storm surge, during years with high sea surface temperatures, as they lower the temperatures providing fast relief to corals during periods of high thermal stress (Heron et al. 2008). Major hurricanes have caused significant losses in coral cover and changes in the physical structure of many reefs in Puerto Rico and the USVI. Based on data from the Caribbean Hurricane Network, there have been a total of 20 hurricanes and tropical storms that have affected St. Croix between 1975 and 2018 with 5 hurricanes occurring between 1995 and 1999. Hurricane David in 1979 caused violent sea conditions and flooding and was followed 5 days later by Tropical Storm Frederick, which resulted in additional flooding. Tropical Storm Klaus in 1984 affected some parts of USVI. Hurricane Hugo in 1989 led to violent sea conditions and major flooding across the USVI. Hurricanes Marilyn in 1995, Bertha in 1996, Georges in 1998, and Lenny in 1999 led to additional impacts to reefs already suffering damage from Hurricane Hugo. Tropical storms and hurricanes in 2004, 2008, 2010 and 2017 also resulted in severe flooding across USVI.

Hurricanes Irma and Maria, which struck within two weeks of each other, were both category V hurricanes with significant seas, which significantly impacted reefs. Flooding from hurricane events leads to transport of land-based sources of pollutants to reefs, along with an influx of freshwater to nearshore environments that affects water quality, in addition to physical damage caused by the storms themselves.

As discussed in Section 5.2, Hurricanes Irma and Maria passed through the Caribbean in September 2017 with Hurricane Maria having a significant impact on St. Croix. Although St. Croix and other areas of USVI are still recovering, assessments of in-water habitats have not been completed in all areas but information to date indicates that damage in reef areas around St. Croix is significant. The Teague Bay TNC Coral Nursery was destroyed on the north eastern end of St. Croix. The TNC Frederiksted Coral Nursery was damaged but it had very few corals and the TNC Cane Bay Coral Nursery faired the best with minimal damage, according to David Gross of TNC. A post-hurricane assessment of coral reefs at 157 sites around Puerto Rico, Culebra, and Vieques found that on average 11% of corals were damaged, however some sites experienced up to 100% damage. Lobed star, elklhorn and staghorn corals were identified as the species which had most damage. (NOAA Report 2018)

The surveys for the Limetree site were done pre-hurricanes. Post surveys have been done and because of the nature of the site and most of the offshore corals being encrusting corals or low relief head corals, no loose corals were noted in the project footprint.

According to the applicant, the development of the south shore industrial complex (what is now Limetree Bay Terminals) began with the dredging of the Harvey Alumina Channel in the early 1960's and the filling of the Krause Lagoon wetlands. Within the area, there are large accumulations of very fine sediment, which originated from dredging and blasting. When seas are rough, they suspend these sediments and the entire inshore area beyond the shelf drop becomes extremely turbid and remains so for extended periods. The aerial shows turbidity and sedimentation plumes observed in the area (Figure 21).

Yet despite this turbidity, the action area continues to provide habitat for ESA-listed corals and the essential feature of elkhorn and staghorn coral critical habitat. ESA corals are found in the area and new recruits have been seen on the reef south of the Limetree Bay Channel.

6.3 Conservation and Recovery Actions Benefiting ESA-Listed Corals and Coral Critical Habitat

The CFMC has established regulations prohibiting the use of bottom-tending fishing gear in certain areas in the federal waters of the Exclusive Economic Zone (EEZ). These areas are either closed to any fishing seasonally or permanently closed to all fishing. The Territory has similar fisheries regulations for both commercial and recreational fishers. In addition to regulations, education and outreach activities as part of the NOAA Coral Reef Conservation Program (CRCP), as well as through NMFS's ESA program, are ongoing through the Southeast Regional Office. NOAA RC has also established a program in Puerto Rico and the USVI to participate in grounding response and carry out restoration activities. The summaries below discuss these measures in more detail.

A recovery team comprised of fishers, scientists, managers, and agency personnel from Florida, Puerto Rico, and USVI, and federal representatives was convened by NMFS and has created a recovery plan based upon the latest and best available information for elkhorn and staghorn corals and their habitat (NMFS 2015).

6.3.1 Regulations Reducing Threats to ESA-Listed Corals

Numerous management mechanisms exist to protect corals or coral reefs in general. Existing federal regulatory mechanisms and conservation initiatives most beneficial to branching corals have focused on addressing physical impacts, including damage from fishing gear, anchoring, and vessel groundings. The Coral Reef Conservation Act and the Magnuson-Stevens Act Coral and Reef Fish Fishery Management Plans (Caribbean) require the protection of corals and prohibit the collection of hard corals. Depending on the specifics of zoning plans and regulations, marine protected areas (MPAs) can help prevent damage from collection, fishing gear, groundings, and anchoring.

The Territorial Government regulates activities that occur in terrestrial and marine habitats of USVI. The V.I. Code prohibits the taking, possession, injury, harassment, sale, offering for sale, etc. of any indigenous species, including live rock (V.I. Code Title 12 and the Indigenous and Endangered Species Act of 1990). Additionally, USVI has a comprehensive, state regulatory program that regulates most land, including upland and wetland, and surface water alterations throughout the Territory, including in partnership with NOAA under the Coastal Zone Management Act, and EPA under the Clean Water Act.

The Coral and Reef Associated Plants and Invertebrates FMP of the CFMC prohibits the extraction, possession, and transportation of any coral, alive or dead, from federal waters unless a permit is issued. Similarly, the CFMC prohibits the use of chemicals, plants, or plant-derived toxins and explosives to harvest coral (50 CFR § 622.9). The CFMC also prohibits the use of pots/traps, gill/trammel nets, and bottom longlines on coral or hard bottom year-round in existing seasonally closed areas in the EEZ (50 CFR § 622.435).

Critical habitat for ESA-listed elkhorn and staghorn corals was designated through a final rule published in 2008. The critical habitat designation requires federal agencies consult on actions may adversely affect critical habitat to ensure that the actions do not result in adverse modification or destruction of the critical habitat. This reduces the threats to elkhorn and staghorn corals by adding a layer of protection to habitat necessary for the conservation of the species.

6.3.2 Other ESA-Listed Coral and Coral Critical Habitat Conservation Efforts

Restoration

The Final Section 4(d) Rule for elkhorn and staghorn corals allows certain restoration activities, defined in the rule as "the methods and processes used to provide aid to injured individuals," when they are conducted by certain federal, state, territorial, or local government agency personnel or their designees acting under existing legal authority, to be conducted promptly without the need for an ESA Section 10 permit. Restoration activities are also carried out to restore damaged critical habitat.

Outreach and Education

The NOAA Coral Reef Conservation Program, through its internal grants, external grants, and grants to the Territory and the CFMC, has provided funding for several activities with an education and outreach component for informing the public about the importance of the coral reef ecosystem of the USVI. The Southeast Regional Office of NMFS has also developed outreach materials regarding the conservation of all ESA-listed corals, and the designation of coral critical habitat. These materials have been circulated to constituents during education and outreach activities and public meetings, and as part of other Section 7 consultations, and are readily available on the web at: https://www.fisheries.noaa.gov/.

6.3.3 Summary and Synthesis of Environmental Baseline for All ESA-Listed Corals and Acroporid Coral Designated Critical Habitat

In summary, several factors are presently adversely affecting all ESA-listed corals and coral critical habitat in the action area. These factors are ongoing and are expected to occur contemporaneously with the proposed action. Marine pollution as a result of coastal development is expected to pose the greatest threat to mountainous star coral colonies and coral critical habitat in the action area based on data from surveys such as Smith et al. (2011), Nemeth and (2001), Hubbard et al. (1987), and T. Smith et al. (2008).
The project area has been significantly and irreversibly impacted in the past due to blasting, dredging and filling, all done prior to the enforcement of environmental regulation, as discussed in 6.2.4. Except for those areas that are relatively shallow and swept by continual wave action, there are large accumulations of fine sediments on hardbottom surfaces. The highest densities of corals noted within the project area were on the revetment for the jetties in very shallow water where they were less subject to resuspended sediments and on the eastern pavement where it was shallower and subject to wave action minimizing settling of fine sediments, as discussed in the benthic resources section (Section 3.5).

Industrial operations, including discharges and accidental spills from previous operators at the facility, at the former oil refinery could have led to the release of contaminants in the nearby environment. (Section 6.2.4). Contaminants documented in marine and groundwater environments at the site include petroleum, methyl-tertiary-butyl ether, chromium, nickel, vanadium 2, lead, arsenic, and mercury (Holmes et al. 2012).

The project area has an established security zone, which restricts recreational boating and fishing due to the presence of the refinery. However, local fisherman tend to cut over and between the channels in their fishing boats in the shallows. (Section 6.2.1). With the placement of the SPM and additional enforcement of the vessel restrictions (Section 6.2), traffic through the area should be minimized.

The sidescan sonar study, performed in the deeper waters for the project, did find a large number of large tires (used as fenders), ropes and other large vessel related debris scattered in the offshore water, especially down the deep slope west of the channel headed seaward towards the SPM anchor location. Tires were found down to almost 700 ft of water depth during the ROV surveys for the SPM anchors.

Continued activities within the area and throughout St. Croix are expected to combine to adversely affect the quality and suitability of coral critical habitat throughout the ranges of elkhorn and staghorn coral, and in the action area. The factors adversely affecting acroporid coral critical habitat around St. Croix have led to a degraded baseline due to sediment and nutrient transport in stormwater runoff and therefore has also affected all ESA-listed corals as well.

7 EFFECTS OF THE ACTION

Effects of the action include direct and indirect effects of the action under consultation, as well as the effects of any interrelated or interdependent activities. Indirect effects are those that result from the proposed action, occur later in time (i.e., after the proposed action is complete), but are still reasonably certain to occur.

As described below, NMFS believes that certain activities of the proposed action are not likely to adversely affect ESA-listed coral. Those activities are discussed in Section 7.1. In addition, we believe that other activities of the proposed action are likely to adversely affect ESA-listed coral, although some of those activities will also have beneficial effects. Those activities are discussed in Sections 7.2 and 7.4.

As part of the Opinion and because the action will result in adverse effects to ESA-listed coral, NMFS must evaluate whether the action is likely to jeopardize the continued existence of the ESA-listed corals and, if so, develop reasonable and prudent alternatives to avoid the likelihood of jeopardy to the species. If NMFS determines the action is not likely to jeopardize the continued existence of these species, NMFS may authorize incidental take, subject to reasonable and prudent measures to minimize the effects of the take.

As described below, NMFS also believes the proposed action is likely to adversely affect designated critical habitat for staghorn and elkhorn coral. These effects are described in Section 7.3. When an action will adversely affect critical habitat, NMFS must evaluate whether a proposed action will result in the destruction or adverse modification of critical habitat and if so, develop reasonable and prudent alternatives to avoid destruction or adverse modification.

7.1 Effects of the Action on that Are Not Likely to Adversely Affect ESA-Listed Corals

As stated above, five ESA-listed corals (elkhorn, mountainous star, lobed star, boulder star, and pillar corals) are present within the Action Area, but are adjacent to the project's immediate impact area and coral relocation footprint. The project could result in impacts to colonies of these coral species due to the resuspension and transport of sediment during the proposed trenching and pile-driving work. Mitigative measures such as turbidity barriers and an open water caisson that would be utilized during the work at the end of the jetty would be implemented. A water quality and environmental monitoring plan would also be implemented to ensure that impacts do not occur by limiting turbidity to 3 NTUs, which is not deleterious to corals nor result in sedimentation that would adversely affect corals. Thus, we believe that the risk of impacts associated with the resuspension and transport of sediment during the proposed trenching and pile-driving work to listed coral colonies would be discountable.

Although sedimentation occurs naturally in the project area, dredging can increase the duration, severity, and frequency of the sedimentation, with detrimental consequences for coral reefs (Erftemeijer et al. 2012; Nugues and Roberts 2003; Riegl and Branch 1995). Sedimentation can directly smother corals, reduce feeding, and deplete energy reserves (Erftemeijer et al. 2012) leading to lower calcification rates (Erftemeijer et al. 2012; Rogers 1990) and reproductive output (Erftemeijer et al. 2012; Jones et al. 2015; Richmond 1993). Global climate change has introduced additional stressors to coral reefs. Increased seawater temperature has led to increased bleaching events, which cause reductions in coral tissue growth, fecundity, calcification, and overall survival rates (Abrego et al. 2010; Glynn et al. 1996). A recent study indicates that coral recruits survive better under warmer temperatures when anthropogenic sedimentation is maintained at the lowest level (30 mg/cm^2) (Fourney and Figueiredo 2017). The study also indicated that at current water temperatures, increasing turbidity from 4.62 to >14.2 NTUs leads to a 50% drop in the survival of *P.astreoides* recruits within the first month. Increasing amounts of anthropogenic sediment considerably increased turbidity and increased coral recruit mortality (Fourney and Figueiredo 2017). High turbidity levels indicate that the sediment that may settle on top of a coral is fine-grained and thus highly deleterious for coral recruits (Erftemeijer et al. 2012). Fourney and Figueiredo (2017), indicate that the maximum allowable turbidity in coral reefs during short-term construction events should be 7 NTU or less.

To ensure that ESA-listed corals are not impacted by turbidity and sedimentation from dredging and/or disposal vessels, the USACE will conduct turbidity monitoring in accordance with a monitoring plan that will be finalized in partnership with NMFS prior to construction. The monitoring plan will include turbidity monitoring stations adjacent to ESA-listed corals if any are found during the resource surveys. Turbidity in these locations must not exceed 3 NTUs above background as measured at the control locations positioned upstream of the dredge. NMFS believes that limiting project related turbidity to 3 NTU or less above background at the monitoring stations will protect corals from project related effects. This metric is more conservative than both the Fourney and Figueiredo paper and the current EPA standard of 29 NTUs over background over background for project related turbidity. Additionally, the action area where corals are present is subject to natural levels of turbidity due to its location near the channel and the associated turbidity with the normal operations of Limetree. The monitoring plan will include adaptive management measures to be implemented to mitigate turbidity in the event that turbidity exceeds 3 NTUs above background at these locations. With the implementation of adaptive management measures based on a monitoring threshold of 3 NTUs, NMFS believes that effects to ESA listed corals will be discountable. The development of monitoring plan with a 3 NTU over background threshold is the basis for NMFS' discountable finding; reinitiation would be required in the event that turbidity persists at levels above 3 NTUs above background at stations near any known ESA listed coral, which is not corrected by the adaptive management measures.

The 5 ESA-listed corals could be affected by the spuds or anchors of work vessels and barges, by the mechanical dredging bucket, and during the lowering of the pipeline, if any of that equipment was to hit or collide with a colony. In order to avoid and minimize the potential for impacts to ESA-listed corals, a detailed benthic assessment was conducted to ensure that colonies of those species are not present within the proposed project impact corridor. Since the entire impact corridor was not surveyed, it is possible that these species will be encountered. In addition, divers would assist during the anchoring or spudding of vessels and during the lowering of the pipeline, to ensure that those activities do not harm with any ESA-listed coral colonies, as well as any non-ESA listed coral species. Furthermore, there are existing channel markers demarcating the navigation channel and all work vessels would operate using dynamic positioning systems and equipment; this would ensure that all work vessels would remain within the designated work areas, preventing potential impacts to areas outside of the project corridor where ESA-listed corals may be present. For these reasons, we believe the risk of impacts to the 5 ESA-listed corals from anchoring or spudding from work vessels associated with the project would be discountable.

The 5 ESA-listed corals could be affected by accidental groundings of VLBCs as they transit to or from the SPM. However, the SPM would be located in waters too deep for groundings by vessels and a vessel would need to travel from the SPM at least 1,130 m to the closest critical habitat area, 1,350 m to the closest known ESA listed coral, and 2,200 m to the coral mitigation site at Ruth Island. Vessels will approach the SPM from the seaward side, which minimizes the opportunities that it may ground. Since the vessels are not underway while berthed, even if it went adrift, the distances to the resources are great enough that the vessel could get under power and maneuver prior to reaching the resources. Therefore, the risk of impacts from groundings to ESA-listed corals from accidental groundings of VLBCs is discountable.

The 5 ESA-listed corals could be impacted by potential spills of fuels during the operation of the proposed project. According to the applicant, there have been fuel or petroleum products spills as part of the past and current operation of the Limetree Bay Terminal facility. Since Limetree acquired the facility, there have been 5 smaller spills (under 84 gallons of product) that were properly reported to the US Coast Guard and cleaned up. The operation of the terminal already involves the transfer of fuel from/to carrier vessels. The proposed project will result in a reduction in the number of vessels traversing near the areas near the documented ESA corals, therefore reducing spill potential. As part of its present operations, Limetree Bay Terminals has in place an Integrated Contingency Plan (ICP), which addresses in detail the facility's plans and actions to prevent and respond to a potential spill of petroleum products during regular and emergency situations, such as hurricanes, and minimize any potential environmental impacts. Fuel transfers are continuously monitored. Limetree has responders on-site during fuel transfers. As described in Section 5.1.1, Limetree has conducted modeling, which accounts for local hydrodynamics and the proposed operations, to ensure that the SPM is designed appropriately, such that spills are unlikely to occur. Based on this information, it is extremely unlikely that a large-scale, acute fuel spill would be severe enough to result in adverse effects to ESA-listed corals. Therefore, we believe that the potential for adverse effects to ESA-listed corals from potential fuel spills during the operation of the proposed project would be discountable.

The 5 ESA-listed coral could be affected by the loss of habitat from the trenching and pipeline activities. All corals require hard substrate for larval and fragment recruitment. The proposed action will result in the loss of 0.9256 ac of hardbottom habitat that could serve as recruitment habitat for the 5 ESA-listed corals. However, this area is very sparsely occupied by these 5 corals. Mountainous star coral occurs at 0.000199 colonies per square ft. The other four species are only present on the artificial structures (dolos), and were not identified to occur on the 590 ac of hardbottom substrate in the area. All colonies of these 5 species are all large, thus indicating that they recruited decades ago based on growth rates. No recruits or juvenile colonies were observed, indicating that these species are not using this area as recruitment habitat. Therefore, we believe that the potential adverse effects to the 5 ESA listed species from the loss of recruitment habitat is discountable.

7.2 Effects of the Action on Mountainous Star Coral from Project Relocation

The benthic surveys for the project verified that mountainous star coral is located within the action area, and may be located within the impact area of the pipeline installation. As described in Section 3.6, we expect that up to 8 mountainous star coral may be encountered within the footprint of the pipeline installation. The applicant proposes to remove all mountainous star coral encountered during the pipeline installation transfer them to the TNC coral nursery in St. Croix for propagation, and then outplant some to the coral mitigation enhancement site on Long's Reef. Relocation of the corals will prevent the mortality that would certainly occur from pipeline installation. However, relocation activities (physically removing the coral from the hardbottom) may result in injury or mortality of mountainous star coral from collection or transport activities.

Coral transplantation can successfully relocate colonies that would likely suffer injury or morality if not moved. Provided that colonies are handled with skill, are reattached properly, and the environmental factors at the reattachment site are conducive to their growth (e.g., water quality and substrate type), many different species of coral have been shown to survive transplantation (Birkeland et al. 1979; Guzmán 1991; Harriott and Fisk 1987; Hudson 2000; Hudson and Diaz 1988; Lindahl 2003; Maragos 1974). Typically, when relocating scleractinian corals (i.e., stony or hard corals) to a similar environment we expect a survival rate of 90% or higher (Tom Moore, NMFS RC, pers. comm. to Kelly Logan, March 17, 2017). Given that the coral will be transferred to an existing coral nursery prior to being outplanted, we expect that the colonies subject to relocation, nursery propagation, and outplanting will have a very high survival rate. Numerous nurseries for corals have been established to support this recovery activity in the past 15 years with the expressed purpose of enhancing wild populations with sufficient densities of the species to promote natural sexual reproduction (Johnson et al. 2011). To date, hundreds of thousands corals have been propagated and outplanted throughout the species' range, with high survival rates.

NMFS believes that the 8 colonies of mountainous star coral that may be located within the impact area would be lethally taken during the proposed action if not relocated. The resource survey documented the density of mountainous star coral and it is assumed there will be 8 within the project area based on extrapolation of the survey. However, the predicted colonies may not actually be found during relocation efforts. Therefore, we believe that up to 8 colonies could be permanently lost due to the project, if not found and relocated. Standard coral transplanting techniques are highly successful and relocating these corals outside the project area is appropriate to minimize the impact of lethal take.

The applicant proposes to relocate up to 8 mountainous star corals if they are encountered within the construction footprint prior to the start of dredging and construction work. We believe this mitigation measure will be practical because coral removal techniques have been observed to be 90% effective, meaning all or most of the coral relocated will likely survive. We believe that transferring these corals to the TNC coral nursery in USVI will be used for staging, fragmenting, and stabilization of corals, prior to being relocated to the coral mitigation enhancement site, will provide conditions likely to be conducive of project success. TNC staff will be available to monitor and maintain these corals while the project is being constructed.

In summary, we believe that up to 8 colonies of mountainous star coral may be lethally taken by the project if not found during the relocation efforts. Therefore, our estimates indicate the lethal take of up to 8 mountainous star colonies or the nonlethal take (i.e., relocation) of up to 7 mountainous star coral colonies (based on a 90% survival rate x 8 corals = 7.2 corals rounded to 7) if they are found.

7.3 Effects of the Action on Elkhorn and Staghorn Coral Critical Habitat

The essential feature of elkhorn and staghorn coral critical habitat will be affected by the destabilization of the hardbottom from trenching activities, by laying pipes and mattresses on the hardbottom surface, and by sedimentation onto hardbottom caused from these activities. The benthic survey completed for the project found that there are 25,700,400 ft^2 (590 ac) of consolidated substrate, including colonized hard bottom and coral reefs that could contain the essential feature of elkhorn and staghorn coral critical habitat with in the project action area. Within Section 1 of the pipeline installation, the trenching off the end of the jetty is proposed in a shallow hard bottom impacting 525 ft^2 of coral critical habitat. Section 2 includes surface lain pipeline that is in shallow water impacting 20,620 ft^2 of hardbottom. Section 3 includes the channel trenching impacting 15,655 ft^2 of hardbottom. Moreover, section 4, to the west of the channel, includes surface lain pipeline impacting 3,520 ft^2 of hardbottom. The estimated total area of elkhorn and staghorn coral critical habitat that will be affected by the installation of the SPM system is 40,320 ft^2 (0.9256 ac). The use of concrete mattresses will prevent the pipe from moving on the seafloor and will protect adjacent elkhorn and staghorn coral critical habitat from future abrasion, thus no future impacts to the essential feature are anticipated.

There are 126 mi^2 of designated elkhorn and staghorn coral critical habitat in the St. Croix unit. Of this, approximately 90 mi^2 are likely to contain the essential feature, based on the amount of coral, rock reef, colonized hard bottom, and other coralline communities mapped by NOAA's National Ocean Service in 2001. Adverse effects to approximately 40,320 ft^2 of elkhorn and staghorn coral critical habitat from the SPM installation represents approximately 0.001607% (90 mi^2 = 2,509,056,000 ft^2; 40,320 ft^2 / 2,509,056,000 ft^2 * 100 = 0.001607%) of the area likely to contain the essential feature within the St. Croix critical habitat unit.

Fracturing the reef framework will permanently destabilize the essential feature rendering it unsuitable and unavailable for coral recruitment and growth. Further, depending on the size and density of the created rubble, it may stay within the previously defined impact area indefinitely, also making the area unsuitable for coral recruitment and growth. This material produced is similar to that from ship groundings and explosive use. Such conditions have been noted to result in significantly lower recruitment rates compared to un-impacted adjacent reef (Fox et al. 2003; Piniak et al. 2010; Rubin et al. 2008). Therefore, we believe that a total of 0.9256 acres of designated critical habitat will be permanently adversely affected by the pipeline installation activities.

7.4 Effects of Proposed Mitigation Actions

The project proposal includes mitigation for elkhorn and staghorn coral critical habitat impacts through the propagation and outplanting of 1,405 elkhorn coral, and 1,545 staghorn coral. We believe the proposed mitigation measures would compensate for the losses of elkhorn and staghorn critical habitat. We believe that this portion of the mitigation proposal would have a beneficial effect on designated critical habitat by accelerating the provision of its intended conservations function. The following analysis shows how we determined that the propagation and outplanting component of the project would provide for the conservation of the species.

Facilitating increased incidence of successful sexual and asexual reproduction is the key objective to the conservation[10] of elkhorn and staghorn corals identified for their designated critical habitat (73 FR 72224, November 26, 2008), based on the species' life history characteristics, population declines, and extremely low recruitment. Therefore, the critical habitat designation identifies the essential feature within the areas occupied by the species that need protection to support that goal. Corals are sessile and depend upon external fertilization in order to produce larvae. Fertilization success is reduced as adult density declines (known as the Allee effect) (Levitan 1991). Since *Acropora* is not able to self-fertilize it requires a certain density (discussed in further detail below) of adult colonies to promote sexual reproduction (*Acropora* Biological Review Team 2005).

Another activity that supports the goal of increased incidence of successful sexual and asexual reproduction is artificial propagation of the species. The Recovery Plan for Elkhorn and Staghorn Coral (NMFS 2015) identifies the following key action necessary to promote conservation:

> *Develop and implement appropriate strategies for population enhancement, through restocking and active management, in the short to medium term, to increase the likelihood of successful sexual reproduction and to increase wild populations.*

The collection, propagation, and outplanting of elkhorn and staghorn corals at a natural and existing coral mitigation site will result in some adverse effects to those corals but will be beneficial overall because it will enhance species recovery by establishing wild populations that are poised to reproduce sexually and asexually, which is achieving the conservation objective of designated critical habitat. Usually, corals are grown to a specific size and planted on suitable

[10] Under the ESA, conservation is equated with recovery of a species (i.e., the species no longer needs the protection of the ESA).

habitat, which creates the beneficial conditions by which they would ultimately become self-sustaining through reproduction.

NMFS performed a REA for the project and determined that, based on the amount of elkhorn and staghorn coral colonies the impacted habitat could support (derived from the abundance criterion in the Acropora Recovery Plan (NMFS 2015), the published growth rate for the species, and the calculated recovery time, 1,405 colonies of elkhorn and 1,545 colonies of staghorn corals, at least 20 cm in size, are required to compensate for impacts to coral habitat. Compensation will occur in the form of transplantation of corals of opportunity and outplanting corals propagated in a coral nursery into the project mitigation sites.

Based on the REA, the applicant proposes to compensate for the loss of 0.9256 ac of the hardbottom essential feature of elkhorn and straghorn coral critical habitat from the impacts of pipeline trenching, sedimentation from pipeline trenching, and laying of pipeline and concrete matting over the. This loss will prevent the future settlement of coral recruits. Therefore, the applicant proposes to outplant a minimum of 1,405 elkhorn and 1,545 staghorn corals created from collecting corals of opportunity and propagating them at the TNC nursery in St. Croix. These propagated elkhorn and staghorn corals will be outplanted to the coral mitigation site. Most of the corals of opportunity would likely not survive on their own because they are unattached to the substrate and subject to continued abrasion and breakage. We believe this mitigation measure will be practical because there have been recent observations of many corals of opportunity in the area, and the coral propagation and outplanting techniques employed by TNC are successful.

7.5 Effects of the Proposed Action on All ESA-Listed Coral Species

Limetree intends to collect up to 500 corals of opportunity fragments potentially consisting of a combination of all seven ESA-listed species. Limetree will transport these fragments to the TNC nursery for propagation in order to outplant up to 250 coral colonies into the coral mitigation site at Ruth Island (see section 3.7). The remainder of the fragments will remain at the TNC nursery site in order to replenish the nursery since the 2017 hurricanes.

Corals of opportunity occur from storm events and groundings that dislodge parts of a colony and they fall to the substrate. They may remain there unattached and continue to survive for a period. However, reattached coral fragments show significantly highly rates of survival as compared to fragments that are left unattached to the due to burial by sediment, part of the fragment being suffocated from laying on the side, and from abrasion from being moved around by waves and currents substrate (Griffin et al. 2015; Lirman 2000). This stress from being unattached reduces the fragment's chances of survival. Although collecting and reattaching corals of opportunity will result in some adverse effects, this action will be beneficial overall because it will substantially increase the chances of fragment survival.

7.6 Summary of the Effects of the Action on Corals, and Coral Critical Habitat

The construction of the proposed project is expected to have permanent adverse effects on up to 8 colonies of mountainous star coral and 0.9256 ac of coral critical habitat. We determined through a REA that 0.9256 ac of critical habitat would be capable of supporting 1,405 colonies of elkhorn coral and 1,545 of staghorn coral when it is functioning at its full recovery value. Thus, project construction will result in the need for outplanting 1,405 colonies of elkhorn and 1,545 of staghorn corals at least 20 cm in size to compensate for impacts to coral habitat. This will have some adverse effects to the species, but will be beneficial overall. Similarly, the collection and reattachment of coral fragments will result in some adverse effects to the species collected, but will be beneficial overall.

8 CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, or local private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this Section because they require separate consultation pursuant to Section 7 of the ESA.

Cumulative effects from unrelated, non-federal actions occurring around St. Croix that may affect green, leatherback, and hawksbill sea turtles, and their habitats, elkhorn, staghorn and lobed star and mountainous star corals, and elkhorn and staghorn coral critical habitat, include the continuation of activities described in the environmental baseline. NMFS is not aware of any other future state, tribal or local private activities that are reasonably certain to occur and have effects to the environmental baseline. Stranding data indicate that human activities lead to sea turtle mortality in waters around St. Croix. Human activities known to kill sea turtles include incidental capture in state fisheries, ingestion of and/or entanglement in debris, vessel strikes, and poaching. The cause of death of many stranded sea turtles is unknown. Many activities affecting sea turtles and coral critical habitat are highly regulated federally; therefore, any future activities within the action area will likely require ESA Section 7 consultation. However, much of the development occurring around USVI that has been shown to affect water quality (in particular through increases in sedimentation rates) does not require federal authorization. Development often has no federal nexus if the project is located on uplands and is small. Depending on the number and location of these developments, sediment and nutrient loading to nearshore waters could become a chronic stressor. Indeed, information from EPA's list of impaired waterways in the USVI for 2010 and 2012 indicates that there were 204 instances where a pollutant caused impairment of the waterway's designated use (http://ofmpub.epa.gov/tmdl_waters10/attains_state.control?p_state=VI&p_cycle=&p_report_type=T). There were 196 instances in 2014 and 206 instances in 2016 of which 34% were due to turbidity (https://www.epa.gov/tmdl/us-virgin-islands-impaired-waters-list). In 2016, of the 32 reported impairments in St. Croix alone, 24 of them were due to turbidity. The most common pollutants causing impairment included turbidity, oxygen enrichment/depletion, pathogens (including coliform bacteria), pH/acidity/caustic conditions, and nutrients. The pattern of water quality degradation in USVI actually accelerated up to 2012 with 3 impairments reported in 2003 and 2004, 5 in 2005, 1 in 2006, 12 in 2007, 37 in 2010, and 90 in 2012. In 2016, 83 impairments were reported.

The fisheries occurring within the action area are expected to continue into the foreseeable future. Numerous fisheries in territorial waters have been known to adversely affect threatened and endangered sea turtles. NMFS is not aware of any proposed or anticipated changes in these fisheries that would substantially change the impacts each fishery has on the sea turtles, ESA-listed corals, and acroporid coral critical habitat covered by this Opinion.

NMFS is not aware of any proposed or anticipated changes in other human-related actions (e.g., poaching, habitat degradation) or natural conditions (e.g., over-abundance of land or sea predators, changes in oceanic conditions) that would substantially change the impacts that each threat has on the sea turtles, ESA-listed corals, and acroporid coral critical habitat covered by this Opinion. Therefore, other than expected increases in impacts from development, NMFS expects that the levels of interactions with mountainous star coral colonies and acroporid coral critical habitat described for each of the fisheries and non-fisheries will continue at similar levels into the foreseeable future.

9 ANALYSIS OF DESTRUCTION OR ADVERSE MODIFICATION OF DESIGNATED CRITICAL HABITAT FOR ELKHORN AND STAGHORN CORALS

NMFS's regulations define *Destruction or adverse modification* to mean "a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (50 CFR § 402.02). We intend the phrase "significantly delay" in development of essential features to encompass a delay that interrupts the likely natural trajectory of the development of physical and biological features in the designated critical habitat to support the species' recovery. Other alterations that may destroy or adversely modify critical habitat may include impacts to the area itself, such as those that would impede access to or use of the essential features. NMFS will generally conclude that a Federal action is likely to "destroy or adversely modify" designated critical habitat if the action results in an alteration of the quantity or quality of the essential physical or biological features of designated critical habitat, or that precludes or significantly delays the capacity of that habitat to develop those features over time, and if the effect of the alteration is to appreciably diminish the value of critical habitat for the conservation of the species. In the preamble to the proposed rule issuing a new regulatory definition of "destruction or adverse modification, we clarified the meaning of ''appreciably diminish'' by explaining that the relevant question is whether the reduction in the value of critical habitat for the conservation of a listed species has some relevance because we can recognize or grasp its quality, significance, magnitude, or worth in a way that negatively affects the value of the critical habitat as a whole for the conservation of a listed species (79 FR 27060, May 12, 2014).

This analysis takes into account the geographic and temporal scope of the proposed action, recognizing that "functionality" of critical habitat necessarily means that it must now and must continue in the future to support the conservation of the species and progress toward recovery. The analysis must take into account any changes in amount, distribution, or characteristics of the critical habitat that will be required over time to support the successful recovery of the species. Destruction or adverse modification does not depend strictly on the size or proportion of the area adversely affected, but rather on the role the action area and the affected critical habitat serves with regard to the function of the overall critical habitat designation, and how that role is affected by the action. Ultimately, we seek to determine if, with the implementation of the proposed action, critical habitat would remain functional to serve the intended conservation role for the species.

The critical habitat rule for elkhorn and staghorn corals identified specific areas where the feature essential to the conservation of Atlantic *Acropora* species occurs in 4 units within the jurisdiction of the United States: Florida, Puerto Rico, St. Thomas/St. John, and St. Croix. The St. Croix marine unit includes the action area for the proposed Limetree project. The action area is on the south side of St. Croix in the reef system within the immediately footprint of the proposed pipeline system, the mitigation enhancement sites, the TNC nurseries, and the areas surrounding St. Croix which fragments of opportunity are being collected.

The St. Croix marine unit comprises approximately 126 mi^2 (80,640 ac). Of this area, approximately 90 mi^2 (57,600 ac) are likely to contain the essential feature of ESA-designated coral critical habitat, based on the amount of coral, rock reef, colonized hard bottom, and other coralline communities mapped by NOAA's NOS Biogeography Program in 2000 (Kendall et al. 2001). The key objective for the conservation and recovery of Atlantic acroporid corals that is the basis for the critical habitat designation is the facilitation of an increase in the incidence of sexual and asexual reproduction. Recovery cannot occur without protecting the essential feature of coral critical habitat from destruction or adverse modification because the quality and quantity of suitable substrate for ESA-listed corals affects their reproductive success. As noted in the rule designating acroporid coral critical habitat (73 FR 72210, November 26, 2008), the loss of suitable habitat is one of the greatest threats to the recovery of elkhorn and staghorn coral populations. Human-caused stressors have the greatest impact on habitat quality for elkhorn and staghorn corals.

The loss of the essential feature or a diminution in the function of the essential feature affects the reproductive success of elkhorn and staghorn corals because substrate for sexual and asexual recruits to settle is lost or unavailable. Critical habitat was designated for elkhorn and staghorn corals, in part, because further declines in the low population sizes of the species could lead to threshold levels that make the chances for recovery low. More specifically, low population sizes for these species could lead to an Allee effect (decline in individual fitness at low population size or density that can result in critical population thresholds below which populations crash to extinction), lower effective density (of genetically distinct adults required for sexual reproduction), and a reduced source of fragments for asexual reproduction and recruitment. In other words, colonies may be separated by too much distance for successful sexual reproduction to occur. Fragmentation and degradation of settlement habitat clearly exacerbates this problem.

Therefore, the key conservation objective of designated elkhorn and staghorn coral critical habitat is to increase the potential for sexual and asexual reproduction to be successful, which in turn facilitates increases in the species' abundance, distribution, and genetic diversity. To this end, our analysis seeks to determine whether or not the proposed action is likely to destroy or adversely modify designated critical habitat, in the context of the Status of Critical Habitat (Section 5.3), the Environmental Baseline (Section 6, the Effects of the Action (Section 7.3), and Cumulative Effects (Section 8). Ultimately, we seek to determine if critical habitat would remain functional to serve the intended conservation role for the species with the implementation of the proposed action, or whether the conservation function and value of critical habitat is appreciably diminished through alterations to the physical or biological features essential to the conservation of a species. The first step in this analysis is to evaluate the project's expected effects on the species' ability to meet identified recovery objectives relevant to the key conservation objective of critical habitat, given the effects of the proposed action.

The final recovery plan for elkhorn and staghorn corals contains Criterion 1, relating to coral abundance, which indicates that a recovered population of staghorn coral requires achieving a density of one colony ($\geq$ 0.5 m diameter in size) per square meter (m^2), throughout approximately 5% of consolidated reef habitat in 5-20 m water depth throughout the species' range. We assume, based on the recovery plan abundance criterion, that the expected conservation potential of critical habitat can be estimated by applying this metric for a recovered population to the area of critical habitat adversely affected by a particular action. Therefore, we applied this criterion to the area of critical habitat predicted to be permanently adversely affected by the proposed action, to calculate the number of colonies of certain size and density the area would have needed to support, to fulfill the population viability requirements identified by the recovery team in Criterion 1. First, we determined the proportion of the area that will be adversely affected that would satisfy the habitat requirement, by calculating the acreage representing 5% of the adversely affected area. This results in an area of 187.29 m^2 (5% of (0.9256 ac x 4,046.86 $m^{2/}$ ac) = 187.29 m^2). Multiplying this affected area by the number of colonies needed per square meter (1 colony $\geq$ 0.5 m diameter) results in a total of 187 staghorn corals (187.29 m^2 x 1 colony / m^2 = 187.29 colonies) $\geq$ 0.5 m diameter. Thus, the 0.9256 ac of critical habitat could be expected to support 187 colonies of staghorn coral at least 0.5 m in diameter post recovery. Through an REA, we calculated that 1,545 colonies 20 cm in diameter would be needed to achieve the functional services of the much larger 187 colonies the critical habitat could support.

Similarly, a recovered elkhorn population requires achieving a density of 0.25 colonies ($\geq$ 1 m diameter in size) per m^2, throughout approximately 10% of consolidated reef habitat in 5-20 m water depth throughout the species' range. First, we determined the proportion of the area that will be adversely affected that would satisfy the habitat requirement, by calculating the acreage representing 10% of the adversely affected area. This results in an area of 374.58 m^2 (10% of (0.9256 ac x 4,046.86 $m^{2/}$ ac) = 374.58 m^2). Multiplying this affected area by the number of colonies needed per square meter (0.25 colonies $\geq$ 1 m diameter) results in a total of 94 elkhorn corals (374.58 m^2 x 0.25 colony / m^2 = 93.64 colonies) $\geq$ 1 m diameter. Thus, the 0.9256 ac of critical habitat could be expected to support 94 colonies of elkhorn coral post recovery.

The REA calculations discussed in Section 3.7.2, determined that the loss of 0.9256 ac of elkhorn and staghorn critical habitat would preclude the development of 94 elkhorn colonies $\geq$ 1 m diameter and 187 staghorn colonies $\geq$ 0.5 m diameter. To compensate for the preclusion of those colonies, 1,405 elkhorn corals and 1,545 staghorn corals 20 cm in size would be needed. The calculations were based on several factors including a colony size of at least 20 cm, a recovery time of 4 years, a growth rate of 10 cm per year, and loss of up to 15% of the colonies based on collection and relocation stress. The applicant proposes compensatory mitigation to outplant 1,405 elkhorn and 1,545 staghorn colonies and monitoring their successful establishment and growth for 5 years. Because the REA calculations are based on the ARP Criteria 1 goals, the proposed mitigation would equivalently achieve the goal of supporting 94 elkhorn colonies ≥ 1 m diameter throughout 10% of the habitat, and 187 staghorn colonies ≥ 0.5 m diameter throughout 5% of the habitat. Since the proposed compensatory mitigation is expected to achieve the goals of the ARP Criteria 1 at the 2 proposed coral mitigation enhancement sites, the conservation value of coral critical habitat at the 2 proposed coral mitigation enhancement sites will be achieved. Therefore, there will be no net loss of conservation value of coral critical habitat because the conservation value of lost coral critical habitat from the pipeline installations will be compensated at the 2 proposed coral mitigation enhancement sites. Thus, we have determined that the proposed action will not result in destruction or adverse modification of coral critical habitat.

10 JEOPARDY ANALYSIS

The analyses conducted in the previous sections of this Opinion serve to provide a basis to determine whether the proposed action is likely to jeopardize the continued existence of ESA-listed corals. In Section 7.0, we outlined how the proposed actions can effect these species. Now we turn to an assessment of the species' response to these impacts, in terms of overall population effects, and whether those effects of the proposed actions, when considered in the context of the status of the species (Section 5.0), the environmental baseline (Section 6.0), and the cumulative effects (Section 8.0), will jeopardize the continued existence of the affected species.

This section evaluates whether the proposed actions are likely to jeopardize the continued existence of mountainous star coral in the wild. To *jeopardize the continued existence of* is defined as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Thus, in making this determination, NMFS must first determine whether the proposed action directly or indirectly reduce the reproduction, numbers, or distribution of a listed species. Then if there is a reduction in one or more of these elements, we evaluate whether it would be expected to cause an appreciable reduction in the likelihood of both the survival and the recovery of the species in the wild.

10.1 Mountainous Star Coral

In the following analysis, we evaluate the effects of the lethal take and nonlethal relocation of mountainous star coral from the action area.

As discussed in Section 7 (Effects of the Action), the proposed action is likely to adversely affect a maximum of 8 colonies of mountainous star coral through destruction of the colonies or relocation if the colonies are found. Of these, we anticipate that up to 8 colonies may be lethally taken by the proposed action if not found during relocation efforts. The proposed action also includes the collection of up to 500 corals of opportunity for the purposes of additional outplanting and restoration, and for replenishing the hurricane damaged TNC coral nurseries. The fragments to be collected may consist of all 7 ESA-listed species as they are encountered, or they may consist of only 1 of the 7 ESA-listed species depending on what is actually encountered. Therefore, this analysis assumes that all 500 fragments will be mountainous star coral. The 500 collected fragments will be propagated at the TNC nurseries and at least 250 will be outplanted at the designated restoration site.

We assess the effects of the proposed action on mountainous star coral populations in the context of our knowledge of the status of each species, their environmental baselines, and the extinction risk analyses in the listing rule. The final listing rule identifies these species' abundance, life history characteristics, and depth distribution, threat vulnerabilities and characteristics that moderate extinction risk. Combined with spatial variability in ocean warming and acidification across the species' ranges, these species' extinction risk is moderated due to their absolute abundances and their habitat heterogeneity, because the threats affecting them are non-uniform, and there will likely be a large number of colonies that are either not exposed or do not negatively respond to a threat at any given point in time.

The collection of up to 500 corals of opportunity for the purposes of additional outplanting and restoration will not result in a reduction in numbers of mountainous star coral colonies. Because we expect most of the fragments to die if not collected, the collection and outplanting of up to 250 fragments should increase the number of colonies. The construction associated with the proposed action will possibly result in a reduction in numbers of mountainous star coral colonies, with a maximum of 8 mountainous star coral colonies lost. There is ample evidence that mountainous star coral has declined dramatically throughout its range. However, the *Orbicella* complex has historically been a dominant species on Caribbean and Florida coral reefs, characterizing the so-called "buttress zone" and "annularis zone" in the classical descriptions of Caribbean reefs (Goreau, 1959). Therefore, we believe that even with the recent declines that there are still high numbers of mountainous star coral throughout its range (likely billions of colonies). As compared to the range-wide population estimates, the potential loss of up to 8 colonies would cause no noticeable change in the abundance of the species.

The collection of up to 500 corals of opportunity for the purposes of additional outplanting and restoration will not result in a reduction in reproduction of mountainous star coral colonies. Because this collection and outplaning is expected to prevent mortality of the fragments and 250 of the colonies collected will be outplanted relatively close to the project site, we expect this to result in an increase in the long-term reproduction of the species in the action area. The construction activities associated with the proposed action may result in a reduction of reproduction due to the loss of the reproductive potential of up to 8 colonies, should they be lethally taken. Even with the loss of 8 colonies, the species' reproduction would not be decreased, even if none of the outplanted 250 corals were this species. According to the resource surveys conducted in June 2017, almost all of the mountainous star coral colonies occur in the larger size classes and most corals observed were larger than 40-cm longest linear dimension. Reproductive output is positively correlated with colony size. In the species for which we have estimates of size at first reproduction, all are larger than 40 cm (average ~100 cm). Thus, we assume that these corals are currently reproductive. Therefore, we believe that the proposed project may result in a reduction in reproduction of mountainous star corals in the wild, however there are still high numbers (likely billion) of mountainous star coral throughout its range and the potential loss of up to 8 colonies for reproduction would cause no noticeable change in the reproduction of the species. Therefore, the reproduction of the species in this portion of its range will persist.

The collection of up to 500 corals of opportunity for the purposes of additional outplanting and restoration will not result in a reduction in the distribution of mountainous star coral colonies. Up to 250 of the coral fragments, which are unlikely to survive not collected, would be outplanted relatively close to the project site, which will not impact the range wide distribution of the species. If the colonies are found prior to project initiation, the colonies will be relocated to local mitigation sites and the colonies will remain in the same area. If not found, up to 8 colonies may be lethally taken. However, the proposed action will not affect the species' current geographic range. The species is present throughout U.S. waters of the western Atlantic and greater Caribbean, including USVI, Florida and the Gulf of Mexico. Within its range it is found within federally protected waters in the Flower Garden Bank Sanctuary, Dry Tortugas National Park, Virgin Islands National Park/Monument, Biscayne National Park, Florida Keys National Marine Sanctuary, Navassa National Wildlife Refuge, and the Buck Island Reef National Monument. Within its range, the species is naturally present or absent at relatively small spatial scales, such as the scale of a reef. The potential lethal take of 8 colonies would not change this natural spatial distribution. Further, the proposed action will not result in a reduction of mountainous star coral distribution or fragmentation of the range since we expect that mountainous star coral will persist within the action area due to relocation of colonies (from the impact area to the artificial reef area). Based on the above, no reduction in the distribution of the species is anticipated.

Based on the analyses above, we conclude that there will be a reduction of numbers and reproduction, but no reduction of distribution of the species. The reduction of numbers and reproduction of up to 8 colonies will not have a measurable effect on the overall population, which as noted above, likely includes billions of colonies throughout its range. Therefore, we believe the proposed action will not appreciably reduce the likelihood of survival in the wild.

We have not completed a recovery plan for mountainous star corals, but the recovery vision statement in the NMFS Recovery Outline indicates that populations of mountainous star coral should be present across the historical range, with populations large enough and genetically diverse enough to support successful reproduction and recovery from mortality events and dense enough to maintain ecosystem function. Recovery of these species will require conservation of the coral reef ecosystem through threats abatement to ensure a high probability of survival into the future. The reduction of numbers and reproduction of up to 8 colonies would not prevent any of these recovery goals. Therefore, NMFS believes that the proposed action is not likely to reduce the likelihood of mountainous star coral recovery in the wild.

10.2 Elkhorn and Staghorn Corals

As noted in Section 7, elkhorn and staghorn coral colonies are expected to be adversely affected by the proposed action due to the loss of elkhorn and staghorn critical habitat from the pipeline installation activities, and well as from the collection of corals of opportunity, nursery stabilization and propagation, and from outplanting the corals of opportunity to the coral mitigation enhancement site. We determined that 1,405 elkhorn colonies and 1,545 staghorn colonies were required to fully compensate for the loss of 0.9256 ac of elkhorn and staghorn critical habitat. Limetree intends to collect corals of opportunity, propagate them in the TNC nursery, and outplant them after the project construction activities are complete. In addition to the corals necessary to compensate for the loss of critical habitat, Limetree will collect 500 additional corals of opportunity, which may include elkhorn and staghorn corals. Thus, up to an additional 500 of each species may be collected and 250 fragments outplanted, which are unlikely to survive if not collected.

Elkhorn and staghorn corals were first listed as threatened under the ESA in May 2006 (71 FR 26852: May 9, 2006). In December 2012, NMFS proposed changing their status from threatened to endangered but in September 2014, but determined that both should remain listed as threatened (79 FR 53852; September 10, 2014). The species have undergone substantial population declines and decreases in occurrence to low levels of coverage throughout their range. Elkhorn and staghorn coral are highly susceptible to a number of threats and cumulative and synergistic effects of multiple threats are likely to exacerbate vulnerability to extinction. The lack of adequate regulatory mechanisms contributes to elkhorn and staghorn corals' vulnerability, particularly in the highly disturbed Caribbean region where localized human impacts are high. The abundance of elkhorn and staghorn coral is a fraction of what it was before the mass mortality in the 1970s and 80s and recent population models forecast the extirpation of elkhorn coral from some locations over the foreseeable future, including a site in Vieques that was included in the Jackson et al. (2014) report. The presence of staghorn coral on reefs throughout its range has continued to decrease. Elkhorn corals occupy habitats from back reef environments to turbulent water on the fore reef, reef crest, and shallow spur-and-groove zone, which moderates the species' vulnerability to extinction although many of the reef environments it occupies will experience highly variable thermal regimes and ocean chemistry due to climate change. Staghorn corals occupy a broad range of depths and multiple, heterogeneous habitat types, including deeper waters, which moderates the species' vulnerability to extinction over the foreseeable future. Elkhorn coral abundance is at least hundreds of thousands of colonies but likely to decrease in the future with increasing threats. Staghorn coral abundance is at least tens of millions of colonies but likely to decrease in the future with increasing threats.

The project is expected to result in the loss of up to 1,405 future elkhorn and 1,545 future staghorn coral colony recruits due to the loss of 0.9256 ac of elkhorn and staghorn critical habitat. The loss of future elkhorn and staghorn coral colony recruits because of the pipeline installation will be offset with the propagation and outplanting of 1,405 elkhorn colonies and 1,545 staghorn colonies. As we discussed in Section 3.7.2, the proposed mitigation amount is based on the amount of elkhorn and staghorn coral the impacted habitat could support (derived from the abundance criterion in the recovery plan), the published growth rate for the species (approximately 10 cm per year, the calculated recovery time (4 years), and a colony of at least 20 cm in size. This proposed mitigation also accounts for an additional 15% of corals that might die due to collection and relocation stress. The project could result in a reduction in numbers of recruits of these species in the action area, but the proposed mitigation will compensate for the loss and should achieve no net loss elkhorn and staghorn coral colonies. Further, 500 corals of opportunity may be collected and up to 250 of the coral fragments, which are unlikely to survive if not collected will be outplanted in the action area. The current population of elkhorn and staghorn in the action area will remain unharmed by the action, and may result in an increase in the abundance of elkhorn and staghorn corals in the action area through outplanting. Thus, the action will not result in a reduction of numbers of the species.

The current populations of elkhorn and staghorn corals within the action area will remain unharmed by the proposed action. It is expected that these corals will continue to spawn and that the recruits will continue to settle on the hardbottom that remains unharmed within the action area. The project is expected to result in the loss of up to 1,405 future elkhorn and 1,545 future staghorn coral colony recruits due to the loss of 0.9256 ac of elkhorn and staghorn critical habitat. The loss of future elkhorn and staghorn coral colony recruits because of the pipeline installation will be offset with the propagation and outplanting of 1,405 elkhorn colonies and 1,545 staghorn colonies, based on the assumptions presented in Section 3.7.2. In addition, 250 fragments will be outplanted, some of which we expect to be elkhorn and staghorn. The outplanting of these colonies will increase the reproductive potential of the species. Therefore, we do not expect the proposed action will result in a reduction in the reproduction for the species.

The project is expected to result in the loss of up to 1,405 future elkhorn and 1,545 future staghorn coral colony recruits due to the loss of 0.9256 ac of elkhorn and staghorn critical habitat. The loss of future elkhorn and staghorn coral colony recruits because of the pipeline installation will be offset with the propagation and outplanting of 1,405 elkhorn colonies and 1,545 staghorn colonies within the action area. The project also includes the collection and outplanting of 250 coral fragments, some which we expect to be elkhorn and staghorn. Thus, the action will not result in a reduction of distribution of the species.

Based on the analyses above, we conclude that there will not be a reduction of numbers, reproduction, or distribution of the species. Therefore, we believe the proposed action will not appreciably reduce the likelihood of survival and recovery in the wild.

10.3 Remaining ESA-Listed Corals – Additional Collection and Outplanting

As discussed in Section 3.7, Limetree will, in addition to the USACE required mitigation, collect up to 500 corals of opportunity, consisting of boulder star, lobed star, pillar, and rough cactus coral, for the purposes of additional outplanting and restoration, and for replenishing the hurricane damaged TNC coral nurseries. The 500 collected fragments will be propagated at the TNC nurseries and at least 250 will be outplanted at the designated restoration site. The fragments to be collected may consist of all 4 ESA-listed species mentioned as they are encountered, or they may consist of only 1 of the 4 ESA-listed coral species depending on what is actually encountered. This action will be generally beneficial for all or those ESA-listed species collected, and will increase the biological diversity within the action area. It will prevent the mortality of these corals were they left unattached and not collected.

The proposed action may not appreciably affect overall density and distribution of the species in the action area, but that the restoration outplanting may have an increase in the long-term reproduction of the species in the action area. This action will enhance and benefit all 4 ESA-listed coral species (or those species represented by the 500 collected corals) by preventing mortality and by increasing their abundance, reproduction and distribution. Therefore, NMFS believes that the proposed restoration is not likely to reduce the likelihood of all 4 ESA-listed coral's survival or recovery in the wild.

11 CONCLUSION

NMFS has analyzed the best available data, the current status of the species and critical habitat, the environmental baseline with the understanding that recent hurricanes may have degraded the baseline, effects of the proposed action, and cumulative effects to determine whether the proposed action is likely to jeopardize the continued existence of mountainous star, boulder star, lobed star, pillar, rough cactus, elkhorn, and staghorn corals or result in the destruction or adverse modification of critical habitat for elkhorn and staghorn corals. It is our Opinion that the construction and operation of the Limetree Bay Terminals, LLC project:

- is *not* likely to jeopardize the continued existence of mountainous star from relocation, and coral fragment collection and outplanting;
- is *not* likely to jeopardize the continued existence of boulder star, lobed star, pillar, rough cactus, elkhorn, and staghorn corals from coral fragment collection and outplanting;
- is *not* likely to result in the destruction or adverse modification of designated critical habitat for elkhorn and staghorn coral;

12 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to Section 4(d) of the ESA prohibit take of endangered and threatened species, respectively, without special exemption. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS). The take of *Orbicella sp.* has not been prohibited by a section 4(d) regulation. However, non-prohibited take is included in the ITS and RPMs and terms and conditions are required.

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. NMFS must estimate the type and extent of incidental take expected to occur from implementation of the proposed action to frame the limits of the take exemption provided in the Incidental Take Statement. These limits set thresholds that, if exceeded, would be the basis for reinitiating consultation. The following section describes the type and extent of take that NMFS anticipates will occur as a result of implementing the proposed action, and on which NMFS has based its determination that the action is not likely to jeopardize listed species.

The USACE has a continuing duty to regulate the activity covered by this incidental take statement. If the USACE (1) fails to assume and implement the terms and conditions or (2) fails to require the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the USACE must report the progress of the action and its impact on the species to NMFS as specified in the Incidental Take Statement (50 CFR §402.14(i)(3)).

12.1 Amount or Extent of Take

NMFS has determined that the proposed project will result in the non-lethal take of up to:

- 1,405 elkhorn fragments
- 1,545 staghorn fragments
- Up 500 total fragments of corals of opportunity (all 7 ESA-listed corals)

NMFS has determined that the proposed project will result in the take of up to 8 mountainous star coral colonies (this take may be non-lethal or non-lethal).

12.2 Effects of the Take

NMFS has determined the anticipated level of incidental take specified in Section 12.1 is not likely to jeopardize the continued existence of the species identified above.

12.3 Reasonable and Prudent Measures

Section 7(b)(4) of the ESA requires NMFS to identify RPMs necessary to minimize the impacts of predicted incidental take and terms and conditions to implement those measures. Only incidental taking by the federal agency or applicant that complies with the specified terms and conditions is authorized.

These measures, terms, and conditions are nondiscretionary, and must be implemented by the USACE or the applicant in order for the protection of Section 7(o) (2) to apply. The USACE has a continuing duty to regulate the activity covered by this ITS. If the USACE or the applicant fails to adhere to the terms and conditions of the ITS through enforceable terms, and/or fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse. To monitor the impact of the incidental take, the USACE or the contractor must report the progress of the action and its impact on the species to NMFS as specified in the ITS [50 CFR 402.12(i)(3)].

NMFS has determined that the following RPMs are necessary or appropriate to minimize impacts of the incidental take of all ESA coral species during the proposed action.

1. The USACE must ensure that all colonies of ESA-listed mountainous star coral are relocated from within the project impact area prior to beginning construction and transplanted to one of the approved coral mitigation sites upon completion of the construction, and after propagated corals reach appropriate outplanting size.

2. The USACE must conduct biological and environmental monitoring.

3. USACE shall include the Conservation Measures discussed in section 3.8 of this document as special conditions of any permit issued for the project in order to minimize the potential impacts to all ESA-listed species.

12.4 Terms and Conditions

The USACE must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are nondiscretionary.

1. Relocation of listed coral species: Since transplantation can be stressful on corals and the natural environment is variable, NMFS believes the best way to minimize stress and ensure the survival of all transplanted colonies is to follow the attached ESA listed coral transplantation and monitoring plan. (RPM 1,3)

2. USACE must record the original location of each transplanted colony, as well as the location of each colony after transplantation. (RPM 1,3)

3. USACE must inventory and track the location, health, and size of all collected coral colonies. (RPM 1,3)

4. USACE shall conduct monitoring of relocated corals in accordance with procedures in the plan referenced in #1. (RPM 2-3)

5. USACE shall submit copies of all mitigation and monitoring reports to NMFS at the letterhead address. The USACE must provide NMFS with all data collected during monitoring events conducted, as well as any monitoring reports generated following the completion of the proposed project. The monitoring programs shall include reporting requirements to ensure NMFS, USACE, and other relevant agencies are aware of corrective actions being taken when thresholds are exceeded, as well as ensure NMFS receives data related to the condition of listed corals in the area due to the importance of these listed species. (RPMs 1-3).

The RPMs, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the implementation of the RPA. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the RPMs provided. The USACE must immediately provide an explanation of the causes of the taking and review with NMFS the need for possible modification of the RPMs.

13 CONSERVATION RECOMMENDATIONS

Section 7(a) (1) of the ESA directs federal agencies to, in consultation with the Services, use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations identified in Biological Opinions can assist action agencies in implementing their responsibilities under Section 7(a) (1). Conservation recommendations are discretionary activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The following conservation recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the federal action agency:

1. We recommend that pre, during, post-construction surveys include surveys for Nassau grouper, and that any sighting of this species be reported to NMFS so that we can update information related to the presence of the species throughout its range.

Please notify NMFS if the federal action agency carries out any of these recommendations so that we will be kept informed of actions that are intended to improve the conservation of listed species or their designated critical habitats.

14 REINITIATION OF CONSULTATION

This concludes NMFS's formal consultation on the proposed action. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal action agency involvement or control over the action has been retained, or is authorized by law, and if (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action on listed species or designated critical habitat in a manner or to an extent not considered in this Opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.

e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006
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Vessel Strike Avoidance Measures and Reporting for Mariners NOAA Fisheries Service, Southeast Region

Background
The National Marine Fisheries Service (NMFS) has determined that collisions with vessels can injure or kill protected species (e.g., endangered and threatened species, and marine mammals). The following standard measures should be implemented to reduce the risk associated with vessel strikes or disturbance of these protected species to discountable levels. NMFS should be contacted to identify any additional conservation and recovery issues of concern, and to assist in the development of measures that may be necessary.

Protected Species Identification Training
Vessel crews should use an Atlantic and Gulf of Mexico reference guide that helps identify protected species that might be encountered in U.S. waters of the Atlantic Ocean, including the Caribbean Sea, and Gulf of Mexico. Additional training should be provided regarding information and resources available regarding federal laws and regulations for protected species, ship strike information, critical habitat, migratory routes and seasonal abundance, and recent sightings of protected species.

Vessel Strike Avoidance
In order to avoid causing injury or death to marine mammals and sea turtles the following measures should be taken when consistent with safe navigation:

1. Vessel operators and crews shall maintain a vigilant watch for marine mammals and sea turtles to avoid striking sighted protected species.

2. When whales are sighted, maintain a distance of 100 yards or greater between the whale and the vessel.

3. When sea turtles or small cetaceans are sighted, attempt to maintain a distance of 50 yards or greater between the animal and the vessel whenever possible.

4. When small cetaceans are sighted while a vessel is underway (e.g., bow-riding), attempt to remain parallel to the animal's course. Avoid excessive speed or abrupt changes in direction until the cetacean has left the area.

5. Reduce vessel speed to 10 knots or less when mother/calf pairs, groups, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity; therefore, prudent precautionary measures should always be exercised. The vessel shall attempt to route around the animals, maintaining a minimum distance of 100 yards whenever possible.

6. Whales may surface in unpredictable locations or approach slowly moving vessels. When an animal is sighted in the vessel's path or in close proximity to a moving vessel and when safety permits, reduce speed and shift the engine to neutral. Do not engage the engines until the animals are clear of the area.

Additional Requirements for the North Atlantic Right Whale

1. If a sighted whale is believed to be a North Atlantic right whale, federal regulation requires a minimum distance of 500 yards be maintained from the animal (50 CFR 224.103 (c)).

2. Vessels entering North Atlantic right whale critical habitat are required to report into the Mandatory Ship Reporting System.

3. Mariners shall check with various communication media for general information regarding avoiding ship strikes and specific information regarding North Atlantic right whale sighting locations. These include NOAA weather radio, U.S. Coast Guard NAVTEX broadcasts, and Notices to Mariners. Commercial mariners calling on United States ports should view the most recent version of the NOAA/USCG produced training CD entitled "A Prudent Mariner's Guide to Right Whale Protection" (contact the NMFS Southeast Region, Protected Resources Division for more information regarding the CD).

4. Injured, dead, or entangled right whales should be immediately reported to the U.S. Coast Guard via VHF Channel 16.

Injured or Dead Protected Species Reporting

Vessel crews shall report sightings of any injured or dead protected species immediately, regardless of whether the injury or death is caused by your vessel.

Report marine mammals to the Southeast U.S. Stranding Hotline: 877-433-8299
Report sea turtles to the NMFS Southeast Regional Office: 727-824-5312

If the injury or death of a marine mammal was caused by a collision with your vessel, responsible parties shall remain available to assist the respective salvage and stranding network as needed. NMFS' Southeast Regional Office shall be immediately notified of the strike by email (takereport.nmfsser@noaa.gov) using the attached vessel strike reporting form.

For additional information, please contact the Protected Resources Division at:

NOAA Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701
Tel: (727) 824-5312
Visit us on the web at http://sero.nmfs.noaa.gov

NMFS Southeast Region Vessel Strike Avoidance Measures and Reporting for Mariners; revised February 2008.

U.S. FISH & WILDLIFE SERVICE
CARIBBEAN ECOLOGICAL SERVICES FIELD OFFICE
JANUARY 2012

TECHNICAL ASSISTANCE TO EVALUATE EFFECTS ON ANTILLEAN MANATEES

The Service considers shallow coastal areas, bays, estuaries, river mouths and mangrove lagoon ecosystems as important for the conservation of the Antillean manatee because these areas contain all the natural elements preferred by manatees: abundant sea grass relatively calm waters, sheltered spots, and freshwater sources, as well as a relatively low number of boats within the bay. Actions proposed for these areas should be carefully examined, to ensure that elements required by this species are not compromised.

To evaluate the potential effect of proposed action on manatees, we need the applicants to address the following issues:

1. Type and amount of watercraft associated to the project

2. Amount of boat facilities (e.g. ramps, piers, dry-stacks, buoys, among others)

3. Amount of habitat to be affected (e.g. acres of sea grasses and/or mangroves)

4. Provisions / restrictions to be taken to prevent collisions with manatees (e.g. delineation of an entrance channel, marking buoys, navigation aids, among others).

5. Outreach efforts to be implemented concerning boat operation. One of the main components of a successful operation of facilities that implement mechanisms to safeguard threatened and endangered species is a comprehensive outreach program that clearly indicates to the public 1) the actions that the facility is undertaking to protect such species (including assurances on the implementation of protection measures), and 2) the activities that the public should take to minimize or prevent impacts to sensitive species and their habitats. Guidelines for safe operation of watercrafts should be included as part of the outreach/education component of the proposed project (example attached below).

6. Any other site-specific conservation measure applicable for the project.

EXAMPLE OF CONSERVATION MEASURES FOR IN-WATER PROJECTS (INCLUDING DREDGING ACTIVITIES)

The following manatee conservation measures are recommended:

1. The contractor instructs all personnel associated with construction of the facility of the presence of manatees and the need to avoid collisions with manatees.

2. All construction personnel will be advised that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Endangered Species Act of 1973 and the Marine Mammal Protection Act of 1972. The permit holder and/or contractor will be held responsible for any manatee harmed, harassed, or killed as a result of construction of the project.

3. The project work area shall be surveyed for the presence of manatees at least one hour before any dredging starts and prior to the installation of the silt fence. If manatees are found before any in-water project activity starts, the contractor shall wait for the manatee to leave the area by itself and be at least 100 feet from the project in-water area. Manatees must not be herded or harassed into leaving the area.

4. Siltation barriers will be made of material in which manatee cannot become entangled, are properly secured, and are regularly monitored to avoid manatee entrapment. Barriers must not block manatee entry to or exit from essential habitat.

5. All vessels associated with the project construction will operate at "no-wake/idle" speed at all times while in water within manatee areas and vessels will follow routes of deep water whenever possible.

6. If manatees are seen within 100 yards (300 feet) of the in-water work area, all appropriate precautions shall be implemented to ensure protection of the manatees. These precautions shall include operating all equipment in such a manner that moving equipment does not come any closer than 50 to 100 feet of any manatee. If a manatee is within 50 feet of in-water work, all in-water activities must shut down, until manatee moves on its own at least 100 feet away from the in-water work area. Manatees must not be herded or harassed into leaving the area.

7. Any collision with and/or injury to a manatee shall be reported immediately to the Department of Natural and Environmental Resources Law Enforcement (787-724-5700) and the USFWS Caribbean Ecological Services Field Office (787-851-7297).

8. The contractor shall keep a log detailing sightings, collisions, or injury to manatees, which have occurred during the contract period. Following project completion, a report summarizing the above incidents and sightings will be submitted to the U.S. Fish and Wildlife Service, Caribbean Ecological Services Field Office, P.O. Box 491, Boquerón, Puerto Rico 00622.

9. The permit holder and/or contractor shall install and maintain temporary and permanent manatee signs as recommended by the following guidelines:

   a. Signs must be placed in a prominent location for maximum visibility. Areas that are recommended include: dock walkways, dock master offices, near restrooms or other high patron foot traffic areas.
   b. Signs must be replaced when faded, damaged or outdated.
   c. If the facility is large or has multiple docks with separate walkways that are a considerable distance apart, multiple signs should be installed.
   d. These signs must not face the water, must never be attached to pilings or navigational markers in the water. Some exceptions to signs facing the water exist for temporary signs during in-water work.
   e. For durability, all signs should be fiberglass, PVC or metal with rounded corners (hand-sanded to remove all sharp edges and burrs), constructed of 0.08 Gauge 5052-H38 Aluminum with an Alodine 1200 conversion coating and Engineer Grade Type I reflective sheeting. Signs constructed to other specifications may not provide durability acceptable to the consumer.
   f. Signs other than depicted may be considered, but should be approved by USFWS.

PRECAUCIÓN: HÁBITAT DE MANATÍ

CAUTION: MANATEE HABITAT

Toda embarcación

VELOCIDAD MÁXIMA 5MPH

All project vessels **IDLE SPEED/NO WAKE**

Si observa un manatí a 50 pies o menos del área de trabajo, toda actividad en el agua debe

DETENERSE

When a manatee is within 50 feet of work all in-water activities must **SHUT DOWN**

Informe cualquier accidente con un manatí.

Report any collision with or injury to a manatee.

Vigilantes DRNA

(787)724-5700

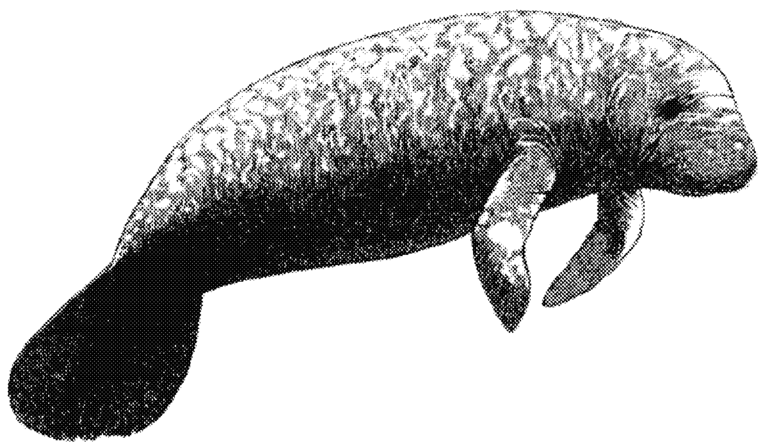
This **temporary** bilingual sign is required as part of the standard manatee construction conditions and is intended to be placed near dredge, tugboat and work boat operators. Minimum size should be at least 8½" inches tall by 11" inches wide, and besides the above recommendation, the sign may be in laminated paper. This sign shall be installed or distributed prior to the initiation of construction. Temporary signs will be removed by the permit holder upon completion of construction.

To obtain a ready to print copy of this sign, please contact the USFWS Caribbean Ecological Services Field Office at 787-851-7297 ext. 220 or by email at jan_zegarra@fws.gov

PRECAUCIÓN

Manatíes en el Área

Caution: Watch for Manatees



VELOCIDAD MÁXIMA 5MPH

IDLE SPEED/NO WAKE

Informe cualquier accidente con un manatí.

Vigilantes DRNA

(787) 724-5700

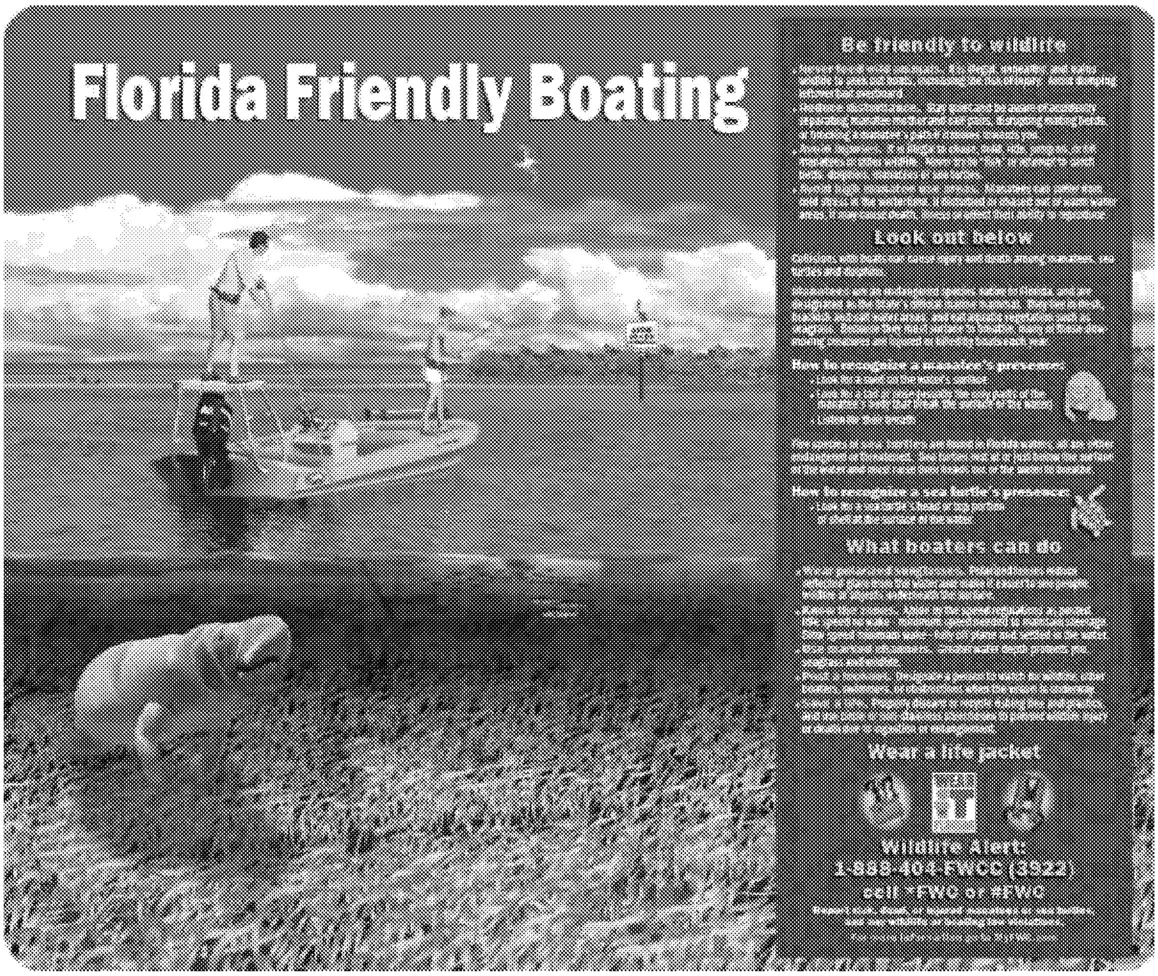
Report collisions, sick, dead or injured manatees.

This **permanent** bilingual sign is required as part of the standard manatee construction conditions and is intended to be placed within docking and launching facilities. Minimum size should be at least 30" inches tall by 24" inches wide with rounded corners. This sign shall be installed prior, during or after project construction. This permanent sign may not be required for coastal projects that **do not** have docking and/or launching facilities.

To obtain a ready to print copy of this sign, please contact the USFWS Caribbean Ecological Services Field Office at 787-851-7297 ext. 220 or by email at jan_zegarra@fws.gov

10. A permanent bilingual manatee educational sign should be installed and maintained prior to mooring occupancy at a prominent location to increase the awareness of boaters using the facility of boats to these animals. The numbers of educational signs that may be installed will depend on the docking facility design. One manatee educational sign is recommended at each boat ramp or travel lift (if applicable). Manatee educational signs remain the responsibility of the owner(s) and the Service recommends the signs be maintained for the life of the docking facility in a manner acceptable to the Corps of Engineers.

EXAMPLE MANATEE EDUCATIONAL SIGN



This **permanent** educational sign should have a minimum size of at least 30" inches tall by 36" inches wide with rounded corners.

11. A notarized verification letter stating that permanent signs have been installed at designated locations shall be forwarded to the Corps of Engineers, Antilles Regulatory Section, as soon as they are installed. Signs and pilings remain the responsibility of the owner(s) and are to be maintained for the life of the docking and launching facility in a manner acceptable to the Corps of Engineers.

12. Signs other than depicted above may be considered, but should be approved by USFWS. Signs shall have at least the following minimal recommend information:

    a. Temporary bilingual signs:

PRECAUCIÓN
MANATÍES EN EL ÁREA
Mantenga velocidad de 5 mph dentro del área de construcción
Informe cualquier incidente con un manatí
Vigilantes DRNA 787-724-5700

CAUTION
MANATEES IN THE AREA
Maintain idle speed/no wake (5 mph) within construction site
Report any collisions with or injury to a manatee

    b. Permanent bilingual signs:

PRECAUCIÓN
MANATÍES EN EL ÁREA
Velocidad máxima 5 mph
Informe cualquier incidente con un manatí
Vigilantes DRNA 787-724-5700

CAUTION
MANATEES IN THE AREA
Idle speed/No wake (5 mph) zone
Report collisions, sick, dead or injured manatees

    c. Permanent bilingual educational sign and some of the of the recommended information it should include:

GUÍA PARA LA PROTECCIÓN Y CONSERVACIÓN DEL MANATÍ
(*MANATEE PROTECTION AND CONSERVATION GUIDELINES*)

1. Utilice gafas polarizadas mientras navega. Éstas ayudan a detectar mejor al manatí, las áreas llanas y cualquier obstáculo en el mar. (*Use polarized sunglasses while navigating. These help to detect any manatee, shallow waters and any other obstacle in the wáter.*)

2. Si usted ve un manatí en la trayectoria de su embarcación, reduzca la velocidad a 5 mph y conduzca la embarcación fuera del paso del manatí o espere a que el manatí salga del área poniendo su embarcación en neutro. (*If you see a manatee within the*

path of your vessel, reduce the velocity to 5 mph and turn your vessel away from the manatee's path or wait until the manatee has moved from the area by putting your vessel in neutral.)

3. Luego de asegurarse de que el manatí esté fuera de la trayectoria de su embarcación, continúe navegando despacio (no más de 5 mph) hasta que su embarcación se encuentre a no menos de 50 pies (15 metros) del manatí. (*After you are certain that the manatee is well outside of the path of your vessel, resume navigation slowly (not more than 5 mph) until your vessel is not less than 50 feet (15 meters) away from the manatee.*)

4. Obedezca las zonas con límites de velocidad y reduzca la velocidad en aguas llanas menores a 10 pies de profundidad en particular cerca de la costa, en las desembocaduras de ríos, en praderas de hierbas marinas y manglares. (*Obey regulatory speed zones and reduce velocity in shallow waters less than 10 feet, particularly close to the coast, in river mouths, in sea grass beds and mangroves.*)

5. Si observa un manatí mientras usted está en el agua, obsérvelo pasivamente, no lo persiga, acose o lo toque. (*If you observe a manatee while in the water, passively observe it, do not follow it, nor harass or touch.*)

6. No tire basura al agua. El manatí puede ingerirla o enredarse en ella, lo cual podría causarle heridas o la muerte. (*Do not throw trash in the water. Manatees may ingest or entangle on trash, which may injure or kill it.*)

7. Nunca alimente o le ofrezca agua a un manatí. Es ilegal y los malacostumbra a acercarse a lugares donde pueden ser lastimados. (*Never feed or give water to a manatee. It is illegal and will wrongly habituate them to approach areas where they can be injured.*)

Informe accidentes con un manatí inmediatamente. Si encuentra un bebé manatí solo, en peligro, herido o muerto, llame al Cuerpo de Vigilantes del Departamento de Recursos Naturales y Ambientales al 787-724-5700 o al Programa de Rescate de Mamíferos Marinos al 787-833-2025, 787-538-4684 ó 787-645-5593. (*Inform any accident with a manatee immediately. If you find a baby manatee alone, in danger, injured or dead, call the Department of Natural and Environmental Resources Law Enforcement of at 787-724-5700 or the Marine Mammal Rescue Program at 787-833-2025, 787-538-4684 or 787-645-5593.*)

Herir o matar un manatí puede conllevar multas de más de $50,000 y/o no menos de dos años de cárcel. ¡EVÍTESE ESE RIESGO!
(*Harming or killing a manatee could carry fines of more than $50,000 and/or not less than two years in prison. AVOID THIS RISK!*)

GRACIAS POR AYUDAR A SALVAR LOS MANATÍES
THANKS FOR HELPING SAVE THE MANATEES

Installation of a Single Point Mooring Water Quality and Environmental Monitoring Including Monitoring for Sea Turtles and Marine Mammals During Periods of Acoustic Impact

Introduction

Limetree Bay Terminals is proposing to install a Single Point Mooring (SPM) off their marine terminal on the south shore of St. Croix.

The proposed project would be located at the Limetree Bay Marine Terminal, 1 Estate Hope, Christiansted, St. Croix, USVI, which is the location of the former Hovensa Oil Terminal Facility. Specifically, the proposed project would be located at 17.687756 °N, -64.740337 °W. The attached figures show the location and the proposed project details. The applicant seeks authorization to install a Single Point Mooring (SPM) and an underwater pipeline system for the offshore transfer of bulk fuel from Very Large Bulk Carriers to the existing facilities at the Limetree Bay Marine Terminal.

The project would include the placement of two concrete coated 30 inches in diameter parallel pipelines from the end of the eastern jetty of the Limetree Bay Terminal to a Pipeline End Manifold (PLEM) to be located offshore at a water depth of 136 feet below mean sea level. Two sections of the parallel pipelines would be placed on the surface of the marine floor, while two other sections would require excavating trenches to allow for the bend radius of the pipelines as they transition off the jetty and as they transition across the channel. The installation of the pipeline, including the surface laid and trenched sections, would be completed in approximately 10 days. At the end of the pipelines, the system would transition into two 24 inches in diameter hoses which would be suspended mid water at a depth of 150 feet to 250 feet to the buoy balance position for the SPM.

In order to delineate the mooring area around the SPM, a navigation buoy would be placed at a depth of 100' adjacent to the pipeline in an area of uncolonized sand. This marker buoy would indicate where the pipeline is located so that ships can avoid this area during maneuvers in the channel. Two additional channel marker buoys would be installed on either side of the channel crossing to alert vessels and their pilots where the pipeline crosses the channel to avoid damage to the pipeline by anchoring. The buoys would be multi-purpose buoys and their anchors would consist of poured concrete blocks measuring 2' x 2' x 2' with a steel ring. The anchor blocks would be poured on shore and taken out with a tug and placed by divers using lift bags. The two channel markers would be placed within the 31-foot disturbance footprint for the channel trenching.

To install the first offshore section of the pipelines, an approximately 15 feet wide trench would be excavated at the seaward end of the eastern jetty. This would require the temporary removal of a section of the revetment of the jetty. The revetment is composed of concrete tetrapods or dolos. In order to allow for the pipe bend radius, the trench would extend approximately 35 feet from the end of the existing revetment footprint. After the dolos are removed, the existing pavement or hardbottom would be broken and approximately 1200 cubic yards of material, including broken hardbottom and sediments, would be dredged from the footprint of the trench. Approximately 445 cubic yards of this material will be dredged seaward of the jetty from the revetment footprint and offshore pavement. The trench will be between 7.5 and 9ft deep in this area. Once the excavation is complete, the pipelines would be placed, the upland trench in the jetty would be refilled with the same material excavated from it, and the dolos returned to their original location to protect the terminus of the jetty. An excavator would be used to create the trench. The removal of the dolos and the trenching would be done from the end of the jetty. The trenching of the rock pavement would be done with an open bucket so that water will drain as the material is removed. The dolos would be temporarily relocated to an uncolonized area of marine floor to the southeast of the project footprint while the pipelines are installed. The material excavated from the shoreline would be temporarily stored on the jetty. The material will be stored in re-enforced silt fences designed so that all runoff from the stock pile is directed back into the trench. The trench seaward of the revetment will not be filled and all remaining dredge material will be carried to an inland disposal site within the refinery to dry. Silt fencing will be placed and maintained around the stored spoils.

The second section of the pipelines would be surface lain on the marine floor to the south over the next 988 feet before turning to the southwest to cross the Limetree Bay Terminal Navigation Channel. The third section of the pipeline corridor would require excavating an approximately 470 feet long, 31 feet wide and average of 16 feet deep trench to accommodate the pipe bending radius into the channel. The trenches outside of the channel crossing are actually just transition trenches and will be as shallow as possible and still achieve the intended purpose of meeting the pipe bending radius. All of the material from the trench will be removed from the water and placed on a spoils barge. The rocky material will dewater on the barge and all discharge water will be directed through a double set of turbidity barriers. It is possible that up to 3 temporary piles may be driven to assist in the exact positioning of the pipelines as they curve into the channel. These piles would be placed with a vibratory hammer and would be driven into the area that will be disturbed by the trenching. The trench would then continue 787 feet across the navigation channel and 660 feet up the western channel slope. Again the material from the excavation of the western slope will be removed from the water and dewatered on the barge. The excavation will be done using an extended arm backhoe or a clamshell or bucket type crane excavator mounted on a barge. The channel floor is soft unconsolidated material which is uncolonized in the area of the crossing. The excavated material would be side cast during the pipe placement and not removed from the water. A total of 40,000 cubic yards of sediments would be excavated. Concrete mats would be placed over the pipes and at critical areas to further protect the pipes. The excavation within the channel would be made so the top of the pipelines would be at minimum depth of 70 feet below mean sea level, so they would be at least 10 feet below the existing channel floor which is 60 feet below mean sea level.

The fourth section of the pipelines would begin once the pipelines emerge from the channel. This section of the pipelines would be surface lain for approximately 2570 feet to a depth of 136 feet where the PLEM would be placed. The system would then transition from the PLEM into two 1,500 feet long and 24 inches in diameter hoses which would be suspended mid water at a depth of 150 feet to 250 feet and would extend to the buoy balance position for the SPM. Floats and weights would be used to help maintain the hoses in position. The SPM would be positioned at a water depth of 665 feet, which would allow for adequate depth for the tankers to swing without getting in to water less than 88 feet. The PLEM would be held in place by gravity blocks. The PLEM would have a frame designed to hold 1000 tons of concrete blocks. The steal PLEM structure would be sat in place on the seafloor and the pre-cast concrete blocks would be lowered into place on the frame work designed to receive them.

Seven anchor piles would be used to stabilize the SPM and two steel anchor piles would be used to stabilize the floating subsea hoses. The hose and SPM anchor piles would be approximately 72 inches in diameter and approximately 80 feet in length. The PLEM, the subsea hoses and the SPM would be connected to their respective anchor pilings via steel chains. The piles will be drilled and grouted piles. The method of drilling and grouting piles into position is an industry wide accepted practice whenever soil conditions prohibit the conventional installation methods of driving piles with a hydraulic or other type of pile driving hammer.

The process begins with the setting of a temporary support frame on the sea floor. The temporary support frame is only used as a guide and for support of the casing. The drilling string and drilling tool will be lowered from the surface into the casing and will begin to drill through the seafloor materials. The process involves no chemicals, nor does it introduce any other foreign materials to the water. This will be done with a very specialized drilling equipment due to the depth of water involved.

As the drilling progresses into the seafloor, the casing is lowered into the drilled hole. Upon reaching the designed depth, the drilling tool will be removed, and the actual pile will be placed inside the casing. The casing will be connected to a crane located on the surface support vessel and will be slowly retrieved from the drilled hole. As this casing removal is occurring, grout will be pumped into the annulus between the pile and the drilled hole. Each pile will require approximately 27.7 cubic yards of grout. The grout used will be calculated for each pile based on drilling and grout placement will be monitored by ROV to ensure overfilling of the annulus does not occur. Once this grout has set, the pile is now secured permanently into place and ready for use. It is anticipated that it will take 2 to 3 days to drill and grout each of the nine piles.

The SPM would be placed in an area of restricted navigation. The PLEM hoses and SPM would be illuminated to allow for clear visibility of these structures.

To deploy and install the pipeline, the concrete pipe segments would be welded together on shore and then slowly pulled into position, and then lowered to the marine bottom in a controlled manner by removal of floats and flooding of the pipe. Divers and/or robots would also assist in the process. This would be done as a continuous 24 hours a day operation without anchoring or spudding of the barge to minimize the potential for pipeline swing, bend and/or damage. This would also avoid potential impacts to benthic habitats from barge anchoring or spudding, as well as from temporary laying down the pipeline on the marine floor. Support bags (offshore bulk bags) would be installed underneath pipeline sections in various locations along the route to rectify unsupported pipeline spans. The bulk bags could vary in weight, depending on the need and location. Typically, the bag would range from 500 pounds up to 2500 pounds. The bags would be filled on the barge with commercially available or manufactured sand material. They would be lifted from the barge and lowered to the marine bottom with a crane. Once near their desired location, divers would assist with exact placement. It is anticipated that there would be approximately ten locations requiring support bags along the current route based on the bathymetric data analyzed. However, an actual visual inspection of the line (once installed) would confirm the exact number, size and location of support bags needed. Articulating concrete block mattresses would be placed on top of selected surface lain sections of the pipeline, to further protect and secure it in place. The concrete mattresses would consist of 8 ft wide and 25 ft long panels. It is anticipated that approximately 250 articulating concrete block mattresses would be installed along the pipeline. Within the trenches 8 ft wide and 15 ft long mattress will be used to stabilize pipelines. These mattresses will extend approximately 3.5 feet to either side of the pipelines. The final pipeline route would be marked prior to the start of construction. The construction footprint of trenched sections of the pipeline would be approximately 31 feet wide at the channel crossing. Off the end of the jetty the trench will be 15 feet wide since this can be done from the jetty. The dredge barges would need to anchor or put down spuds in preselected locations to dredge or excavate the trenches within the proposed pipeline corridor.

According to applicant estimates, the entire project impact corridor would occupy an area of approximately 4.33 acres of marine bottom, of which approximately 0.9256 acres would consist of pavement or hardbottom areas which support the essential features of Acropora spp. designated critical habitat. The installation of the SPM will give Limetree Bay Terminals, LLC the ability to handle bulk fuel shipments from Very Large Bulk Carriers. Vessels with drafts of up to 79ft require a minimum clearance of 88ft. of water. Receiving bulk fuel shipments eliminates the need to transfer fuels to smaller vessels to be handled within the port facility. The SPM will make the Limetree Bay Terminal facility much more financially viable and will result in fewer ships necessary to carry the same amount of product. It is anticipated that the installation will reduce ship traffic through the channel and its adjacent critical habitat by 40 to 50 ships a year.

An extensive alternative analysis was undertaken to determine the alternative which avoids ESA corals, minimizes impact to critical habitat, impact to corals and seagrasses and minimizes water quality impacts. The chosen alternative is that which avoided impacts to the greatest extent possible and minimized those impacts that are unavoidable. The corals which lie in the potential impact footprint will be transplanted to minimize impact. Water Quality and Environmental Monitoring plans will be implemented during all in-water work. Limetree Bay Terminals, LLC has an Integrated Contingency Plan which will encompass the SPM.

Construction Methods

The project will include the placement of two concrete coated 30" OD pipelines which will be trenched into the eastern jetty so that them may emerge onto the seafloor. this will require the temporary relocation of the tetra-pods or dolos. An uncolonized area, the southeast of the project footprint, has been identified and the dolos will be temporarily stored in that area while the pipelines are buried. The dolos will be relocated by a land based crane. To minimize the impact of the oncoming seas and prevent erosion during excavation, an open-ended caisson or cofferdam enclosing the excavation area will be installed. In order to minimize turbidity impacts, turbidity barriers will be installed to the west (the predominant wave and current direction) to prevent suspended sediments from impacting the corals which have colonized the shoreline dolos and riprap. Many of these corals are the ESA listed *Acropora palmata* and *Orbicella faveolata*. The excavated material from the jetty will be temporarily stored on the jetty and protected by re-enforced silt fencing while stock piled, and any runoff water directed back into the open trench. Once the excavation is complete the pipelines will be placed, the trench refilled (only landward of the end of the jetty) and dolos returned to protect the terminus of the jetty. No material will be placed back in the trench seaward of the existing terminus of the jetty. Any remaining dredge spoil material will be carried inland by truck and disposed in a designated dredge spoil storage area for drying. The dredge spoil storage area will be surrounded by re-enforced silt fencing. . The pipelines will be surface lain to the south over the next 988' before turning to the southwest to cross the Limetree Channel. The pipelines will be pre-constructed and will be pulled off the jetty and then weighed and slowly sunk into position. Divers will assist in the placement and sinking of the pipelines. The pipelines will be trenched down the channel wall. The trenching will be done by a barge mounted crane or excavator. This will be done with a 15ton dredge bucket capable of breaking the rock pavement. The bucket is not a sealed bucket and water will discharge from the bucket as the collect material is deposited into the spoils holding containment barge. The material which will be rocky in nature will dewater on the barge. Discharge points from the barge will be contained within double set of turbidity barriers. Additional barriers will be placed to the southwest to divert turbidity towards the channel where the fines can settle in the deeper calmer water of the channel. The trench will not be refilled and the dredge spoils from the pavement and slope will be taken to the roll on-roll off ramp and carried by truck to a dredge spoil storage area that will be surrounded by re-enforced silt fencing. The channel will then be trenched. And finally, the transition out of the channel to the west will be dredged. The material will be rocky in nature will dewater on the barge. Discharge points from the barge will be contained within double set of turbidity barriers. Additional barriers will be placed to the southwest to minimize the spread of turbidity over the sandy plain. The trench will not be refilled and the dredge spoils from the pavement and slope will be taken to the roll on-roll off ramp and carried by truck to a dredge spoil storage area that will be surrounded by re-enforced silt fencing.

In total 21,203 cubic yards of material will be excavated during the pavement and slope trenching. This material which will primarily rock in nature and will be de-watered on the barge. The material will be transferred inland at the Roll-on/Roll-off ramp and will then be placed in a dredge spoil storage area within the terminal. The storage area will be surrounded by re-enforced silt fencing.

Table 1. Volume of Dredge Spoils to be Deposited in Uplands.

Source	Volume Cubic Yards
Seaward from end of Jetty	445
Eastern Pavement and Channel Slope	8634
Western Channel Slope and Pavement Below Western Sand Veneer	12,124
Total Volume Dredge Spoils to be Removed to Uplands	**21,203**

Figure 1 Location of Roll-on/Roll-off Ramp (RO/RO) and upland dredge spoil storage.

The material from the in-channel dredging will be side cast to limit the turbidity of the material being brought to the surface and dewatered.

The excavation within the channel will be made so the top of the pipelines will be at minimum of 70' so they will be 10ft below the existing channel floor which is 60ft of depth. Once the pipelines emerge from the channel on the western side, they will be surface lain to a water depth of 136' where the PLEM will be placed. The PLEM will be held in place by concrete gravity weights. The system will then transition into two 24'OD hoses which will be suspended mid-water column at a depth of 150' to 250' to the buoy balance position for the SPM. Floats and weights will be used to hold the hoses in position and 7 anchors will be used to stabilize the SPM in a position at 665' of water depth which will allow for adequate depth for the tankers to swing without getting in to water less than 88ft in depth. Two anchors will be placed on the floated hoses. The hose anchors and the SPM will be anchored with anchor piles which are 60" in diameter and 80' in length. The pilings will be drilled and grouted. All of the piling locations are uncolonized. Because of the depth of water associated with the anchors, there are no turbidity control devices which can be deployed. It is probably that plumes will be created but based on the sediments within the area but there is limited colonization to be affected. The activities will be monitored by ROV including the grouting of the piles to ensure that the annulus is not overfilled.

Critical Areas and Possible Trouble Spots

Detailed environmental surveys were conducted prior during the design of the project and findings during those studies have been used to develop the selected alternative. The project has been designed to minimize the benthic footprint and to avoid ESA species and critical habitat to the greatest degree possible. The pipeline is coming off the end of the eastern jetty which reduces the overall foot print length over 2000' compared to coming off the center jetty and almost 3000' if it had come off the western jetty. The ESA species are present in the area and both *Acropora palmata* and *Orbicella faveolata* area present on the dolos and on the offshore pavement and channel edge. These species were mapped and were avoided in the project footprint as well as the potential impact footprint. The route has been designed to cross the channel as quickly as possible to get into areas of sand. The crossing is being made at the point with the easiest slope transition down into and up out of the channel without impacting ESA species. The PLEM is being placed in 136' water depth rather than below the buoy to avoid zigzagging the pipeline down the slope which is colonized by scattered black corals, *Cirrhipathes leutkeni*. The PLEM is being placed in an area with scattered sponge colonization on a pavement with a sand veneer. The anchors to balance the buoy in place will be placed in areas of open sand/soft sediment devoid of colonization. The areas are clear enough so that the anchor chains will not affect black corals or sponges.

The final pipeline route will be marked prior to construction. The engineers are estimating that the construction footprint (turbidity impacts, material spillage, anchoring, spudding) may be 65' wide coming off the jetty therefore all the corals throughout the first 70' (twice the distance of the offshore trenching) along the route which are within 50' of the centerline of the route will the transplanted, the first 50-60' is minimally colonized and worse case, 20 corals will require relocation. These corals will be transplanted to the recipient site south and west of Ruth Island. There are corals, including ESA corals, on the dolos and on the pavement to the west of the trench excavation. The shallow area off the end of the jetty is almost continually pounded by on coming waves from the southeast and as such the placement of turbidity barriers around the end of the jetty is not possible. The turbidity will be carried to the northwest from the excavation across the pavement to the southeast. A double set of turbidity barriers will be placed to intercept the turbidity from reaching the dolos on the eastern jetty. The turbidity will be directed more towards the channel and ship basins. Because of the wave turbulence in this area, sediments are unlikely to settle until they reach deeper calmer waters (channel and basin) except in the event of an extremely calm day. If an extremely calm day does occur, divers will remove sediments which have settled on the hardbottom.

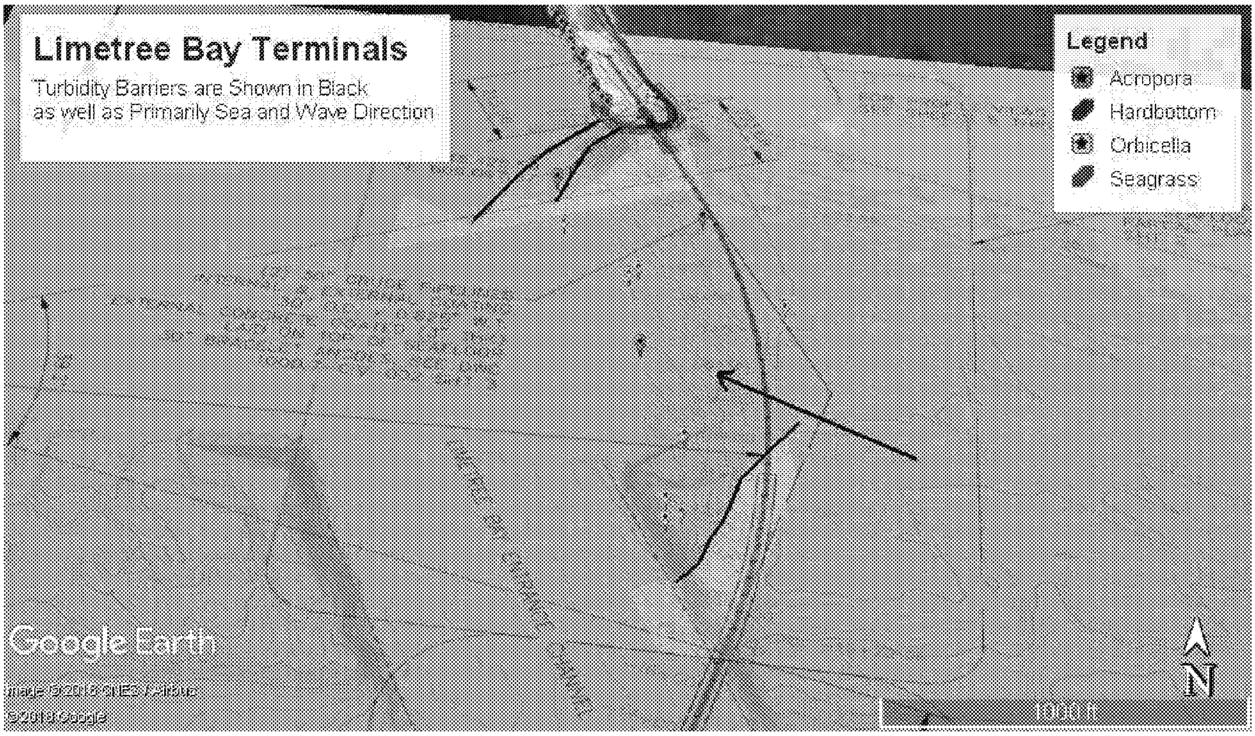


Figure 2. Estimated areas of turbidity impacts and proposed controls.

The area offshore of the jetties is a rock pavement composed of old reef material and limestone. The breaking of this material will create acoustic impacts and therefore turtle and marine mammal monitoring will occur during all rock breaking activities. The area is going to be too turbulent to effectively use bubble curtain, but the turbulence will help to dissipate acoustic impacts.

Over the next 988', the pipelines will be surface lain and will have an impact area of approximately 19.6' (pipelines and mattresses) of width, corals within 20' of either side of the centerline of route will be transplanted to the recipient site to the south and west of Ruth Island. Approximately 920 corals will require relocation. The transition in to the channel will be trenched and assuming the worst-case scenario a disturbance foot print 65' in width will be required, this includes turbidity impacts, spudding and anchoring impacts. Corals within 50' of the centerline will be transplanted to the proposed recipient site near Ruth Island. A total of 1081corals will be transplanted from this area. On the slope the abundance of corals significantly decreases to only 0.0036 corals/sf and less than 40 corals will require transplanting.

The seafloor composition in this area is a pavement composed of broken coral and limestone. This material will be removed and disposed of in the old borrow pit to the north of the airport.

The channel floor is a soft unconsolidated material which is uncolonized in the area of the proposed crossing. The excavated material will be side cast during the pipe placement, a total of 40,000cy of material will be excavated. The material will be side cast rather than lifted completely out of the water and creating the turbidity throughout the entire water column. By keeping the excavated material near the seafloor, it will keep the turbidity plumes near the uncolonized seafloor and very sparsely colonized lower area of the channel walls. Keeping the material in the water also avoids having the material dewater on the barge while waiting to re-fill the trench.

Like the eastern side of the channel, the channel wall has minimal colonization and approximately 40 corals will be relocated from a swath 100' in width to allow the trenching of the pipeline.

A total of 1760 corals are estimated to be relocated. *Diploria strigosa, D. clivosa, Porties astreoides* and *Siderastrea siderea* are the most abundant corals in the area. The project footprint and impact area avoid all ESA corals; however, it is possible that several *Orbicella faveolata* may occur in the potential impact area near the channel crossing. *Orbicella*'s abundance on both the pavement and on the channel walls was 0.00019/sf and due to the sparseness of these corals on the channel walls, it is extremely unlikely that one is within the footprint of impact on the channel walls and was missed during diver survey.

There were also no *Orbicella* in the first 70ft of the route off the end of the jetty, however in the potential area of disturbance at the transition into the channel, it is possible that an *Orbicella* was overlooked in the potential disturbance footprint which is 65ft in width and transplant footprint 100' in width. Six (6) *Orbicella*s may occur in the potential area of impact based on their densities on the pavement. If *Orbicella*s or any other ESA coral is encountered, the applicant will to transplant them out of the impact footprint to ensure their survival. The Nature Conservancy has requested these corals so that they may use them in their nursery program.

Very specialize equipment will be used to drill and grout the deep anchors, and a contractor skilled in work at these depths will be utilized. Placements of all components will the surveyed by SCUBA or ROV and a report regarding the installation will be provided to the agencies.

Siltation Control Measures to be Implemented

Re-enforced silt fencing will be installed to contain the stockpiled excavated material at the end of the jetty. Runoff from the temporary stock will be directed back into the open trench. A double set of Type 3 turbidity barriers will be installed to intercept turbidity impacting the coral colonized dolos.

A caisson or cofferdam will be placed to help stabilize the pipeline trench off the end of the jetty, and minimize the erosion and resuspension of sediment which could result form waves impacting the exposed jetty soils.

Material excavated in the channel will be side cast rather than brought to the surface to minimize turbidity impacts and to prevent the material from dewatering and creating additional turbidity and spreading suspended sediments.

A double set of turbidity barriers will be placed around the discharge points from the spoils barge, and a double set turbidity barriers will be placed to the northwest of the eastern channel slope trenching and the western channel slope dredging.

Water Quality Monitoring

Prior to the start of construction, a baseline of water quality conditions will be established. Location of the baseline sampling locations are shown below in Figure 3. During construction a total of five (6) sampling locations will be established within the SPM potential impact footprint and two (2) control sites, one to the east and one to the west of the project area. The monitoring samples will be collected in the areas most likely to be impacted by the installation activities. Sample sites will be adjacent to the current area of work, and if two areas of work are ongoing, two sets of samples will be collected, and both areas will be monitored. Sample will be taken outside of turbidity barriers and in a radial pattern surrounding the activity. An additional sample will be taken twice daily within the transplant site to ensure water quality is not being affected. The control sites will be located in areas which should be exposed by the same ambient conditions but should not be impacted by the construction project.

At each site the turbidity expressed as NTUs, Dissolve Oxygen, and pH will be analyzed with a YSI meter. Samples will be taken at a depth of 1 meter and a depth of 1 meter off the seafloor where possible. The YSI meter will be calibrated daily before use. Below 30m samples will only be taken to a depth of 30m due to YSI cable length. Samples will be taken on a weekly basis for two (2) months prior to the start of construction. Baseline data will be used to compare with data collected during the construction to help assess whether readings are a result of the construction project or are due to ambient conditions.

The site locations for the baseline study are illustrated on Figure 3.

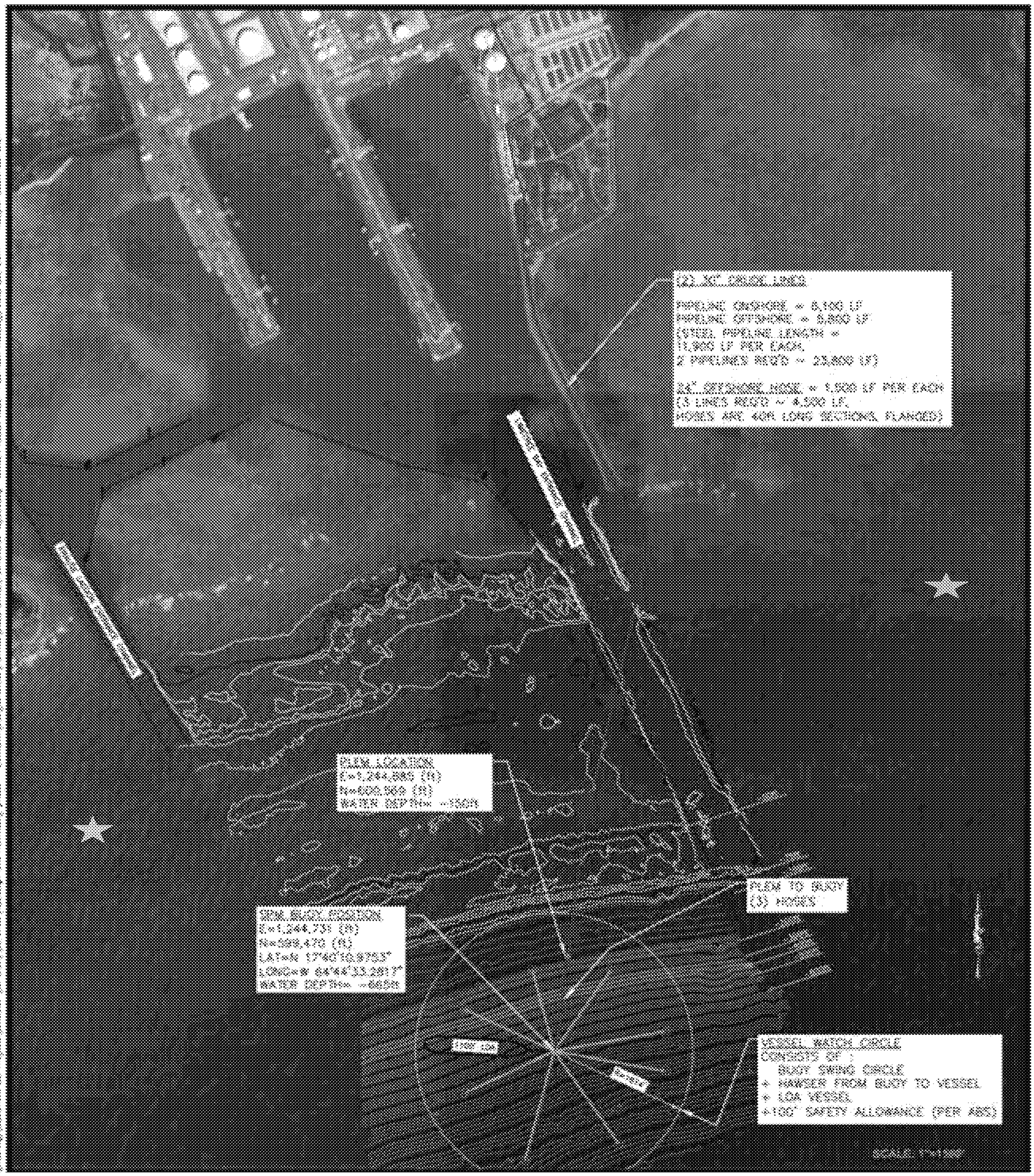


Figure 3 - Water Quality and Environmental Monitoring Locations Baseline

Green stars represent the control sites and red star the monitoring comparison sites.

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During Construction

During in water construction, four (4) samples will be taken immediately around the area of in-water work within the impact area. In water work will include trenching, filling, pipeline installation, anchor placement and pile placement and any and all activities which might affect water quality. And if there are multiple areas of work on going, multiple sets of samples will be taken. Samples will be taken one (1) meter below the surface and 1m from the seafloor up to 30m in depth and will be analyzed for turbidity expressed as NTUs, Dissolve Oxygen, and pH with a YSI meter twice a day during all in-water construction. Samples will be taken radially around the area of ongoing work, and if plumes are noted will be taken within the plume. Monitors will watch throughout the day and will sample when they see potential turbidity impacts. Samples will be taken no less than twice a day and at least 4 hours apart. Monitors will inform the contractors when they see issues with the turbidity control or see issue which may affect corals. Monitoring divers will also note water quality issues or turbidity control issues noted as they are surveying activities.

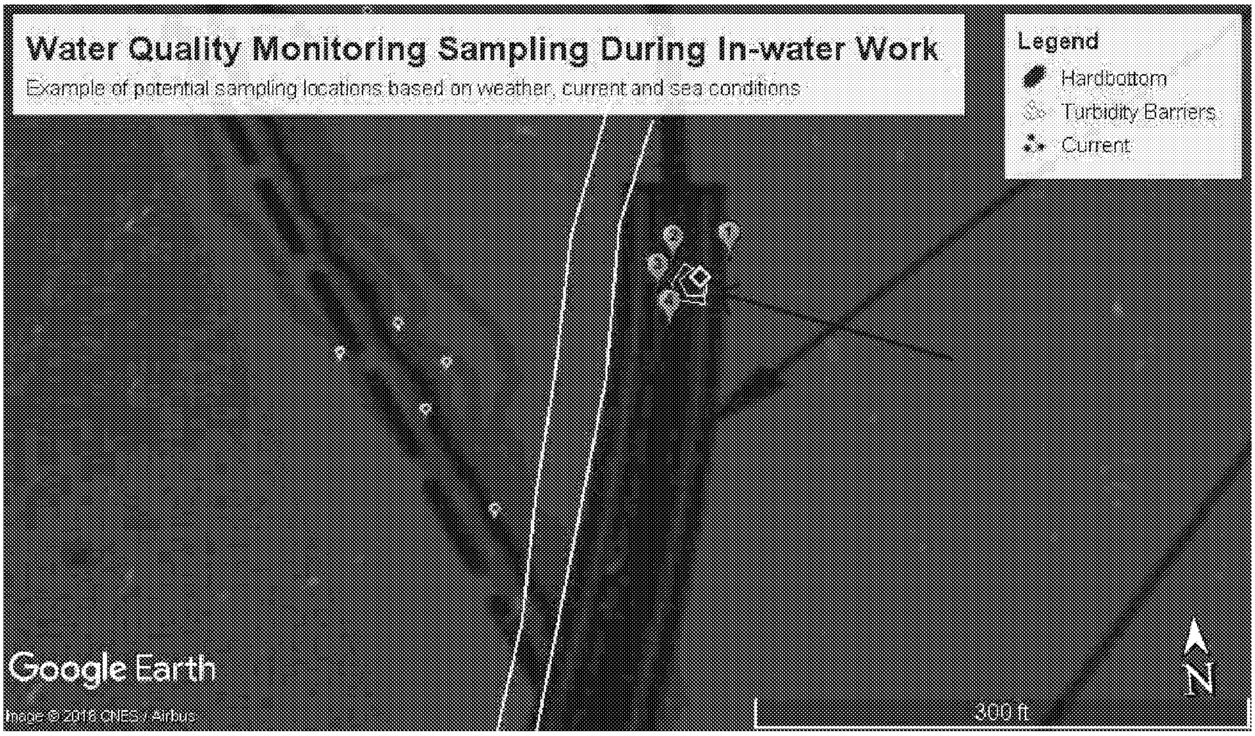


Figure 4 – Potential Locations of Monitoring Samples During In-Water Work (white square is work barge)

The control samples will be utilized to determine whether elevated turbidity is a function of the project or due to ambient conditions. As per the Virgin Islands Code, visual depth visibility readings (Secchi disk measurements) should not fall below one (1) meter; NTU readings may not exceed three (3) NTU in class C waters.

Baseline samples will be utilized to determine if elevated readings are the result of sea conditions.

Wind speed and direction, wave height and direction, and rainfall will be recorded at the time of sampling.

If turbidity becomes elevated and exceeds 3 NTU activities will cease until the issue is resolved and turbidity falls below 3 NTU. In the event background or ambient turbidity levels exceed 3 NTU, activities will cease if samples around the construction area exceed the background levels. Activities will cease until turbidity falls back to ambient levels.

During construction, when the water samples show NTUs readings in excess of the allowable limits, Department of Planning and Natural Resources (DPNR), Division of Environmental Protection (DEP) and Limetree Bay Terminals will be notified by email. The baseline samples will be utilized to determine if an increase in turbidity is a result of natural phenomena or if the monitoring sample is elevated above the ambient background as a result of the installation. If it is determined that the elevated turbidity is the result of the installation, the source of the problem will be identified, and methods worked out to reduce suspended sediments in the future. If turbidity cannot be control by implementing additional measures the activity must slow down to limit introduction of fines and will have to stop every time turbidity exceeds 3 NTU and allow water to clear. A representative must be on hand at the site at all times who has the authority to implement sediment control devices, so that problems can be solve or resolved by the monitor, Limetree, DEP, and DPNR.

Environmental Monitoring

In order to assist minimizing potential impacts and to help ensure coral resources including ESA listed species, monitoring divers will be on site through the pipeline installation, including the trenching, drilling, grouting and placement of pipes. Divers will dive and photograph and video on going activities and assist in the location of the barge to avoid impact to resources, and transplant additional corals and seagrass if needed. Monitors will photograph and describe any noted impact to surrounding corals and remediate any potential impacts to the greatest degree possible (ie dust corals on which sediment has settled or remove debris or replant seagrass). Weekly reports will be provided to CZM, DEP, ACE, EPA, and NMFS. Divers will pay particular attention to any ESA corals within the vicinity of ongoing work.

Monitors will work with the contractor to locate anchoring or spudding locations and will move corals or seagrasses as necessary. Corals would be relocated into the transplant zone for future monitoring. If seagrasses are encountered and cannot be avoided they will be relocated into the seagrass recipient are which has been identified in the Mitigation Plan for the project.

Once activities move into water depths greater than 100ft an ROV will be used to monitor the activities and to document any potential impacts. Weekly reports will be provided to CZM, DEP, ACE, EPA and NMFS.

Once the installation is complete a final report will be prepared documenting the entire installation and providing a video of the installed components.

The system will be monitored on a monthly basis for the first 6 months after installation to assess any potential impacts and then on a semiannual basis for the life of SPM.

In order to monitor the impact of the construction of the construction and operation of the project on the ESA corals within the area, 25 quadrats encompassing ESA corals both on the dolos and on the critical habitat will the established. Quadrats of both *Acropora palmata* and *Orbicella spp.*

will be established and photographed for 2 months prior to the start of construction as a baseline. These corals will then be monitored on a monthly basis during construction and for the first year following construction. Percent live tissue, color, mucus production, discoloration and bleaching will be recorded and used a sign of health.

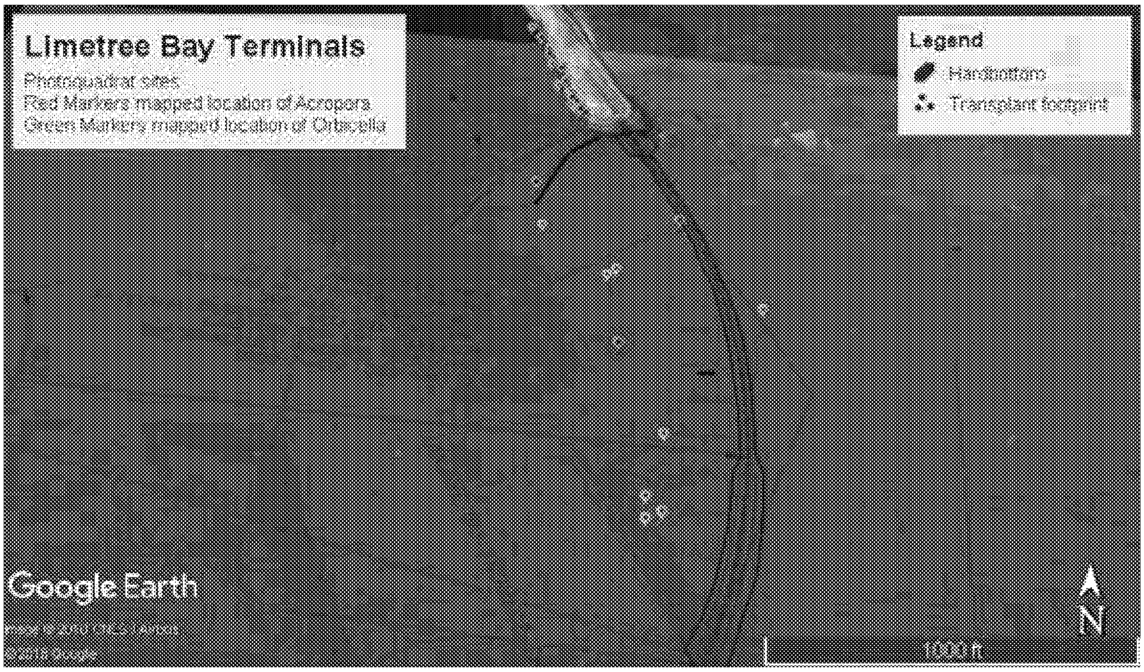


Figure 5. Photoquadrats will be established to encompass the ESA species found on the critical habitat and dolos.

Reports will be provided monthly throughout construction. After the first year, the quadrats will be monitored on a bi-annual basis for a period of 5 years to look at any long-term impact of the project on ESA species.

Monitoring to Minimize Acoustic Impacts

Four federal rare and endangered sea turtle species are known to occur in and around the Limetree Bay Terminal. These include: hawksbill (*Eretmochelys imbricata*), leatherbacks (*Dermochelys coriacea*) Loggerhead (*Caretta caretta*) and green turtles (*Chelonia mydas*).

Green, hawksbill and loggerhead turtles were seen during surveys between June and July of 2017 and leatherbacks are known to nest on the small beach to the east of the jetty. It is not anticipated that the rock trenching will result in direct injury to these species, but it is probable that this could result in changes to their behavior if they were to come into in the area. It is probable that they would be stressed by the noise. In order to minimize that impact to sea turtles and all of the other protect species, mitigation measures will be implemented to minimize potential impact during trenching.

Proposed Minimization Methods

The trenching of rock has the potential acoustic impacts. Because of rough sea conditions, the installation of bubble curtains would not be effective.

The following measures will be implemented to minimize impacts to protected species of sea turtles, and marine mammal.

A 500-m safety zone shall be established around the project area for sea turtles and marine mammals. Trained observers will be used to visually monitor the safety zone for at least 30 minutes prior to beginning all noise creating in-water activities.

If at any time, a sea turtle or marine mammal is observed in the safety zone the operation will be shut down until the animal has left the safety zone of its own volition. Divers will also be observing for turtles and marine mammals and if any area seen the surface will be notified and work will stop until the animal leaves the area.

Observations for protected species will occur throughout the day to maintain watch for animals in the area. If at any time an animal is observed in the safety zone during the noise creating in-water activity, work shall cease until the animal has left the area of its own volition, or coordination with a DPNR representative has occurred, if the animal is injured.

The pipeline installation must occur on a 24/7day a week basis since the pipe is lain as a continuous structure. Stopping the lay at night would require either the barge anchor or spud down when in shallow water and the pipeline could swing in the passing seas potentially damaging the pipe and increasing the potential area of impact. The other option would be to lay the pipe down at night and the grapple for it in the morning which would also increase the area of impact and could potentially damage the pipe.

The barge will be well lit during the lay and monitors will monitor the area around the barge on a continuing basis taking whatever action is necessary to ensure that sea turtles and marine mammals are not impacted. Vessels will move ahead dead slow and if a sea turtle comes within the immediate vicinity of the barge and activity at night the activity will stop until the turtle leaves the area of its own volition. Divers will also be working in the well-lit area and will be able to inform monitors of the presence of turtles.

Records will be maintained of all sea turtle and marine mammal sightings in the area, including date and time, weather conditions, species identification, approximate distance from the project area, direction and heading in relation to the project area, and behavioral observations. When animals are observed in the safety zone, additional information and corrective actions taken such as a shutdown of trenching equipment, duration of the shut-down, behavior of the animal, and time spent in the safety zone will be recorded. Reports will be provided to NMFS, ACE, and CZM on a monthly basis.

Cleanup and Stabilization Activities to Prevent Impact to Critical Habitat

Trenching

During the trenching, divers will identify any large loose rocks or piles of material which have fallen outside the trench and have the trenching contractor remove them. Once the trenching has moved out of the area, divers will collect smaller rocks and cobbles and place them in baskets to be removed from the water and disposed in an upland area. As the divers move along, if fine sediments have collected on the rock divers will use small plastic bristled brushes and slowly scrap the material into a pile it can either then be placed by hand and or swept in to a bag which can be sealed, placed in a basket and lifted to the surface. We did this at AT&T with the bentonite spill. It usually takes 2 to 3 passes to get all of the fines. It is also critical that the bags be placed in a basket for removal to the surface to prevent bags breaking or opening and spilling the fines. Once the area is clean a video will be made and presented to the agencies of the restored hardbottom.

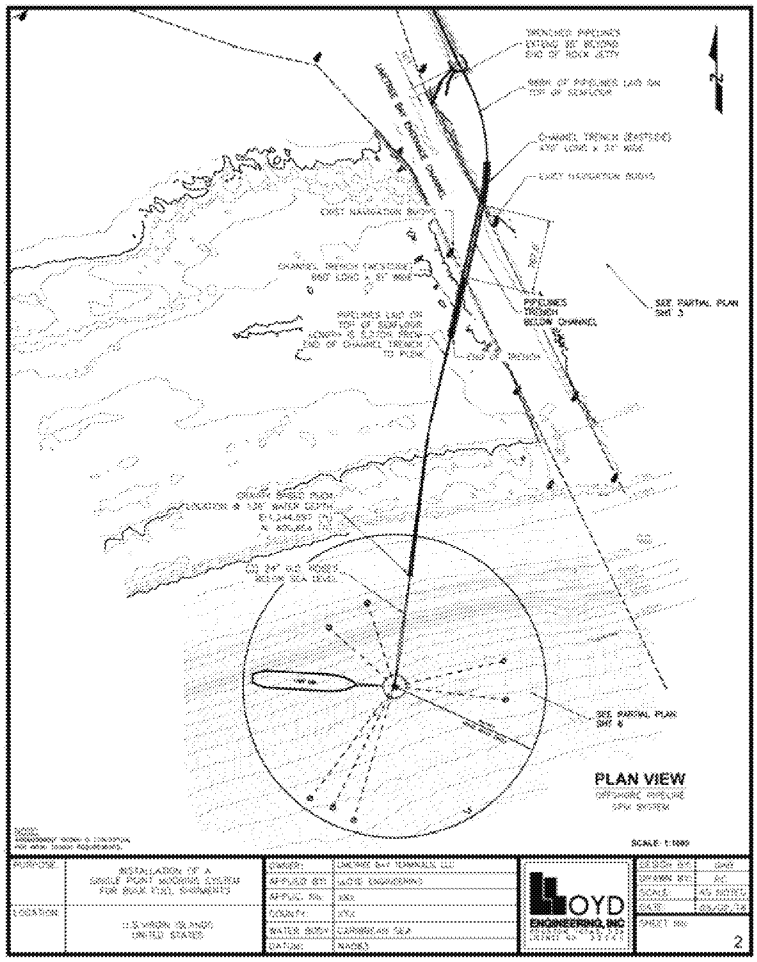
In order to prevent impact to critical habitat in the future caused by the open trench, if it were to undermine or contain rocks or fines that could be washed out, the trench will be surveyed by divers as soon as the pipelines and mattresses have been placed. Any small loose rocks or small piles of fine material will be removed by divers. Divers will collect smaller rocks and cobbles and place them in baskets to be removed from the water and disposed in an upland area. As the divers move along, if small pockets of fine sediments have collected in the trench the rock divers will use small plastic bristled brushes and slowly scrap the material into a pile it can either then be placed by hand and or swept into a bag which can be sealed, placed in a basket and lifted to the surface. Larger areas with fine material will be cemented or grouted to leave the trench with a solid or consolidated floor. Once the area is completed a video will be made and presented to the agencies of the stabilization of the trench.

MINIMIZATION AND COMPENSATORY MITIGATION PLAN FOR IMPACTS TO ESA LISTED SPECIES, ESSENTIAL FISH HABITAT AND CRITICAL HABITAT

FOR

LIMETREE BAY TERMINAL'S

SINGLE POINT MOORING INSTALLATOIN



PREPARED BY

BIOIMPACT, INC.

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REVISED NOVEMBER 2018
ADDITION OF BOND AMOUNT FEBRUARY 2019

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This plan follows the compensatory mitigation guidelines as set forth in 40 CFR Part 230, Compensatory Mitigation for Loses of Aquatic Resources: Final Rule. The fundamental objective of compensatory mitigation is to offset environmental losses resulting from unavoidable impacts to the waters of the United States authorized by DA permits.

I. INTRODUCTION

Limetree Bay Terminals is proposing to install a Single Point Mooring (SPM) off the existing marine terminal on the south shore of St. Croix.

The proposed project would be located at the Limetree Bay Marine Terminal, 1 Estate Hope, Christiansted, St. Croix, USVI, which is the location of the former Hovensa Oil Terminal Facility. Specifically, the proposed project would be located at 17.687756 °N, -64.740337 °W. The attached figures show the location and the proposed project details. The applicant seeks authorization to install a Single Point Mooring (SPM) and an underwater pipeline system for the offshore transfer of bulk fuel from Very Large Bulk Carriers to the existing facilities at the Limetree Bay Marine Terminal.

The project would include the placement of two concrete coated 30 inches in diameter parallel pipelines from the end of the eastern jetty of the Limetree Bay Terminal to a Pipeline End Manifold (PLEM) to be located offshore at a water depth of 136 feet below mean sea level. Two sections of the parallel pipelines would be placed on the surface of the marine floor, while two other sections would require excavating trenches to allow for the bend radius of the pipelines as they transition off the jetty and as they transition across the channel. The installation of the pipeline, including the surface laid and trenched sections, would be completed in approximately 10 days. At the end of the pipelines, the system would transition into two 24 inches in diameter hoses which would be suspended mid water at a depth of 150 feet to 250 feet to the buoy balance position for the SPM.

In order to delineate the mooring area around the SPM, a navigation buoy would be placed at a depth of 100' adjacent to the pipeline in an area of uncolonized sand. This marker buoy would indicate where the pipeline is located so that ships can avoid this area during maneuvers in the channel. Two additional channel marker buoys would be installed on either side of the channel crossing to alert vessels and their pilots where the pipeline crosses the channel to avoid damage to the pipeline by anchoring. The buoys would be multi-purpose buoys and their anchors would consist of poured concrete blocks measuring 2' x 2' x 2' with a steel ring. The anchor blocks would be poured on shore and taken out with a tug and placed by divers using lift bags. The two channel markers would be placed within the 31-foot disturbance footprint for the channel trenching.
To install the first offshore section of the pipelines, an approximately 15 feet wide trench would be excavated at the seaward end of the eastern jetty. This would require the temporary removal of a section of the revetment of the jetty. The revetment is composed of concrete tetrapods or dolos. In order to allow for the pipe bend radius, the trench would extend approximately 35 feet from the end of the existing revetment footprint. After the dolos are removed, the existing pavement or hardbottom would be broken and approximately 1200 cubic yards of material, including broken hardbottom and sediments, would be dredged from the footprint of the trench. Approximately 445 cubic yards of material will be from seaward of the jetty from the revetment footprint and offshore pavement. The trench will be between 7.5 and 9ft deep in this area. Once the excavation is complete, the pipelines would be placed, the upland trench in the jetty would be

refilled with the same material excavated from it, and the dolos returned to their original location to protect the terminus of the jetty. The trench seaward of the revetment will not be filled. An excavator would be used to create the trench. The removal of the dolos and the trenching would be done from the end of the jetty. The trenching of the rock pavement would be done with an open bucket so that water will drain as the material is removed. The dolos would be temporarily relocated to an uncolonized area of marine floor to the southeast of the project footprint while the pipelines are installed. The material excavated from the shoreline would be temporarily stored on the jetty. The material will be stored in re-enforced silt fences designed so that all runoff from the stock pile is directed back into the trench.

The second section of the pipelines would be surface lain on the marine floor to the south over the next 988 feet before turning to the southwest to cross the Limetree Bay Terminal Navigation Channel. The third section of the pipeline corridor would require excavating an approximately 470 feet long, 31 feet wide and average of 16 feet deep trench to accommodate the pipe bending radius into the channel. The trenches outside of the channel crossing are actually just transition trenches and will be as shallow as possible and still achieve the intended purpose. It is possible that up to 3 temporary piles may be driven to assist in the exact positioning of the pipelines as they curve into the channel. These piles would be placed with a vibratory hammer and would be driven into the area that will be disturbed by the trenching. The trench would then continue 787 feet across the navigation channel and 660 feet up the western channel slope. The excavation will be done using an extended arm backhoe or a clamshell or bucket type crane excavator mounted on a barge. The channel floor is soft unconsolidated material which is uncolonized in the area of the crossing. The excavated material would be side cast during the pipe placement. A total of 40,000 cubic yards of sediments would be excavated. Concrete mats would be placed over the pipes and at critical areas to further protect the pipes. The excavation within the channel would be made so the top of the pipelines would be at minimum depth of 70 feet below mean sea level, so they would be at least 10 feet below the existing channel floor which is 60 feet below mean sea level.
The fourth section of the pipelines would begin once the pipelines emerge from the channel. This section of the pipelines would be surface lain for approximately 2570 feet to a depth of 136 feet where the PLEM would be placed. The system would then transition from the PLEM into two 1,500 feet long and 24 inches in diameter hoses which would be suspended mid water at a depth of 150 feet to 250 feet and would extend to the buoy balance position for the SPM. Floats and weights would be used to help maintain the hoses in position. The SPM would be positioned at a water depth of 665 feet, which would allow for adequate depth for the tankers to swing without getting in to water less than 88 feet. The PLEM would be held in place by gravity blocks. The PLEM would have a frame designed to hold 1000 tons of concrete blocks. The steal PLEM structure would be sat in place on the seafloor and the pre-cast concrete blocks would be lowered into place on the frame work designed to receive them.

Seven anchor piles would be used to stabilize the SPM and two steel anchor piles would be used to stabilize the floating subsea hoses. The hose and SPM anchor piles would be approximately 72 inches in diameter and approximately 80 feet in length. The PLEM, the subsea hoses and the SPM would be connected to their respective anchor pilings via steel chains. The piles will be drilled and grouted piles. The method of drilling and grouting piles into position is an industry wide accepted practice whenever soil conditions prohibit the conventional installation methods of driving piles with a hydraulic or other type of pile driving hammer.

The process begins with the setting of a temporary support frame on the sea floor. The temporary support frame is only used as a guide and for support of the casing. The drilling string and drilling tool will be lowered from the surface into the casing and will begin to drill through the seafloor materials. The process involves no chemicals, nor does it introduce any other foreign materials to the water. This will be done with a very specialized drilling equipment due to the depth of water involved.

As the drilling progresses into the seafloor, the casing is lowered into the drilled hole. Upon reaching the designed depth, the drilling tool will be removed, and the actual pile will be placed inside the casing. The casing will be connected to a crane located on the surface support vessel and will be slowly retrieved from the drilled hole. As this casing removal is occurring, grout will be pumped into the annulus between the pile and the drilled hole. Each pile will require approximately 27.7 cubic yards of grout. The grout used will be calculated for each pile based on drilling and grout placement will be monitored by ROV to ensure overfilling of the annulus does not occur. Once this grout has set, the pile is now secured permanently into place and ready for use. It is anticipated that it will take 2 to 3 days to drill and grout each of the nine piles.

The SPM would be placed in an area of restricted navigation. The PLEM hoses and SPM would be illuminated to allow for clear visibility of these structures.

To deploy and install the pipeline, the concrete pipe segments would be welded together on shore and then slowly pulled into position, and then lowered to the marine bottom in a controlled manner by removal of floats and flooding of the pipe. Divers and/or robots would also assist in the process. This would be done as a continuous 24 hours a day operation without anchoring or spudding of the barge to minimize the potential for pipeline swing, bend and/or damage. This would also avoid potential impacts to benthic habitats from barge anchoring or spudding, as well as from temporary laying down the pipeline on the marine floor. Support bags (offshore bulk bags) would be installed underneath pipeline sections in various locations along the route to rectify unsupported pipeline spans. The bulk bags could vary in weight, depending on the need and location. Typically, the bag would range from 500 pounds up to 2500 pounds. The bags would be filled on the barge with commercially available or manufactured sand material. They would be lifted from the barge and lowered to the marine bottom with a crane. Once near their desired location, divers would assist with exact placement. It is anticipated that there would be approximately ten locations requiring support bags along the current route based on the bathymetric data analyzed. However, an actual visual inspection of the line (once installed) would confirm the exact number, size and location of support bags needed. Articulating concrete block mattresses would be placed on top of selected surface lain sections of the pipeline, to further protect and secure it in place. The concrete mattresses would consist of 8 ft wide and 25 ft long panels. It is anticipated that approximately 250 articulating concrete block mattresses would be installed along the pipeline. Within the trenches 8 ft wide and 15 ft long mattress will be used to stabilize pipelines. These mattresses will extend approximately 3.5 feet to either side of the pipelines. The final pipeline route would be marked prior to the start of construction. The construction footprint of trenched sections of the pipeline would be approximately 31 feet wide at the channel crossing. Off the end of the jetty the trench will be 15 feet wide since this can be done from the jetty. The dredge barges would need to anchor or put down spuds in preselected locations to dredge or excavate the trenches within the proposed pipeline corridor.

The entire project impact corridor would occupy an area of approximately 4.33 acres of marine bottom, of which approximately 0.9256 acres would consist of pavement or hardbottom areas supporting the essential features of Acropora spp. designated critical habitat.

The installation of the SPM will give Limetree Bay Terminals, LLC the ability to handle bulk fuel shipments from Very Large Bulk Carriers. Vessels with drafts of up to 79' require a minimum clearance of 88ft. of water. Receiving bulk fuel shipments eliminates the need to transfer fuels to smaller vessels to be handled within the port facility. The SPM will make the Limetree Bay Terminal facility much more financially viable and will result in fewer vessels being needed to carry the same volume of fuel.

An extensive alternatives analysis was undertaken to determine the alternative which avoids ESA corals, minimizes impact to critical habitat, impact to corals and seagrasses, and minimizes water quality impacts. The chosen alternative avoided impacts to the greatest extent possible and minimized those impacts that are unavoidable. The corals which lie in the potential impact footprint will be transplanted to minimize impact. Water Quality and Environmental Monitoring plans will be implemented during all in-water work. Limetree Bay Terminals, LLC has an Integrated Contingency Plan which will encompass the SPM.

II. OBJECTIVES

The objective of this mitigation plan is to minimize the impact of the installation of the Single Point Mooring and to compensate for those impacts that do occur.

III. SITE SELECTION

The recipient sites for the transplanted corals and potential seagrass transpalnt have been chosen because they are a similar habitat type and are relatively close to the impacted site. The corals which do occur to the south and west of Ruth Island appear to have less sediment induced stress than those seen on the western reef, so the area is a more suitable transplant site than the closer western reef which is periodically impacted by turbidity created by large vessels. The recipient site supports the same species as found within the impact area. The site also is colonized by *Acropora palmata, Orbicella faveolata, O. annularis*, and *Dendrogyra cylindrus*.

If seagrasses are encountered and must be transplanted, they will be planted up current to minimize turbidity impacts and will be transplanted at the same depth into the exact same habitat.

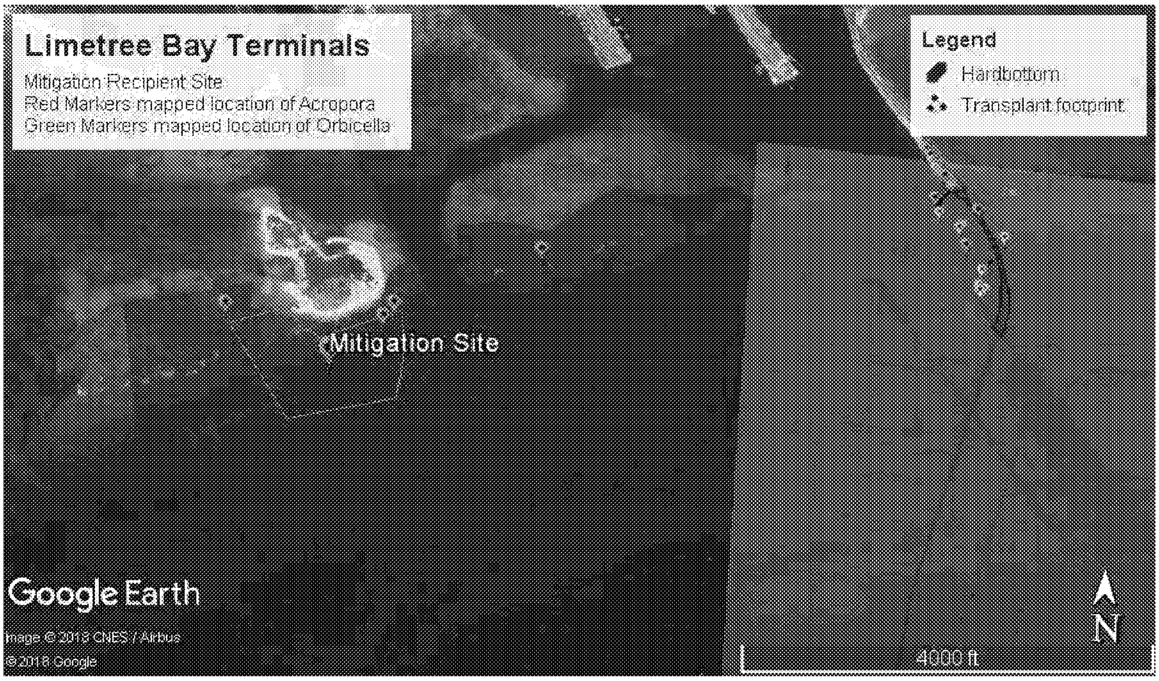

Figure 1. Mitigation Recipient Site, the approximate boundaries of the mitigation site are17°40.787'N 64°45.524'W, 17°40.962'N 64°45.533'W, 17°40.902'N 64°45.684'W, 17° 40.961'N 64°45.766'W, 17°40.927'N 64°45.865'W and 17°40.741'N 64°45.722'W.

As compensatory mitigation Limetree Bay Terminals will be doing an out planting of 1405 *Acropora palmata,* and 1545 *Acropora cervicornis* a portion of this out planting will be done in the St. Croix East End Marine Park (EEMP). The proposed location of the proposed-out planting will be approximately 6.25 miles to the east of the project site off of Great Pond.

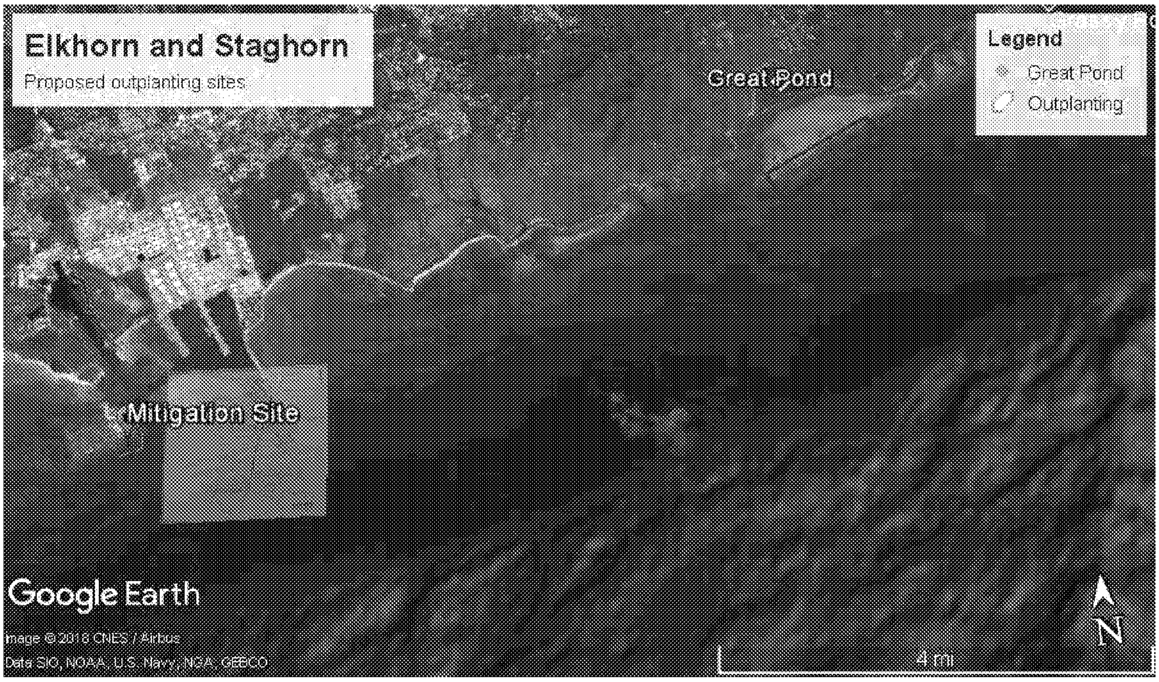

Figure 2: Location of proposed additional out planting site in the EEMP in relationship to the project area.

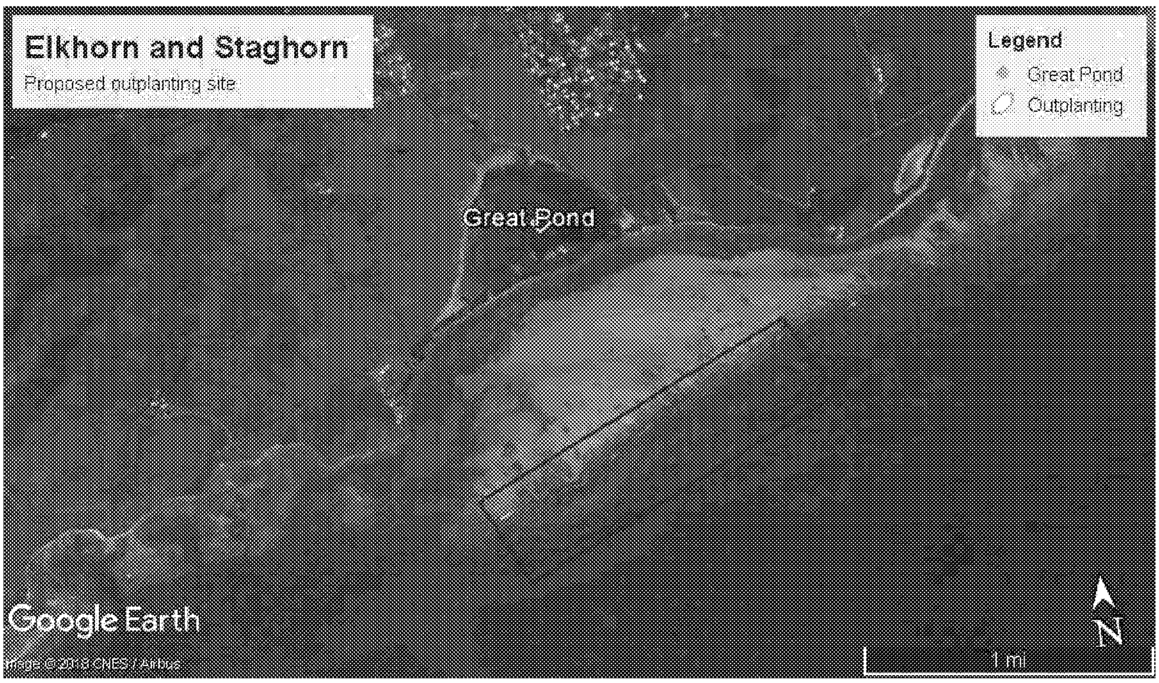

Figure 3. Proposed out planting area. Approximate boundaries: 17°43.071'N 64° 38.620'W, 17°42.610'N 64°39.662'W, 17°42.357'N 64° 39.524'W and 17°42.811'N 64° 38.470'W.

IV. SITE PROTECTION INSTRUMENT

The recipient site is off shore of Ruth Island, Limetree Bay Terminals will install 2 buoys in order to protect the transplanted species. The additional out planting site is within the EEMP and is protected by virtue of being in the marine park.

V. BASELINE INFORMATION

The Limetree facility has revetted jetties which are moderately colonized by coral and sponge species. The coral colonization on these jetties includes ESA listed corals including *Acropora palmata, Orbicella annularis, O. franksi and Dendrogyra cylindrus.* Limetree Channel extends seaward from the east basin at a depth of over 60ft. The channel is cut into limestone and steep slopes characterize the channel out to its seaward end. On the eastern side of the channel, a shallow rock pavement extends from the end of the jetty seaward. The water is only 6 to 8' deep off the end of the eastern jetty. The pavement is sparsely colonized by hard and soft coral species at the end of the jetty, but the abundance of corals and sponges increases seaward. An *Acropora palmata* recruit which had not yet branched and a small *Acropora palmata* were both found on this eastern pavement. The skeletons of *Acropora* are common scattered across the pavement. Several hundred feet off the end of the jetty a few *Orbicella* sp. become present. The algae *Halimeda* becomes more abundant on the pavement as you move offshore.

The channel edges vary in slope due to the substrate integrity and stability. The greatest coral and sponge colonization is in the upper several feet of the channel and the area closer to the channel floor is colonized primarily by algal species.

The channel bottom is composed of soft sediment and is basically uncolonized with a few scattered hydroids. The western side of the channel has what was once a well-developed reef crest located about 2300' off the end of the western jetty. Between the cross channel and the reef crest, there are scattered seagrass beds of *Thalassia testudinum* and *Syringodium filiforme*. Beyond the reef crest irregular rock pavement extends off shore with a scattered sand veneer. The hard bottom and the reef crest is minimally colonized with by scattered corals. There are a few areas of scattered seagrass, primarily *Syringodium filiforme*, with a few small patches of *Thalassia testudinum* on the sand veneer south of the reef. The seagrass beds are all slightly raised above the surrounding sand plains and algal beds.

On the southern plain between 50 and 150ft there are expansive algal beds where *Halimeda* is the dominant algae and densely cover large areas. Between 50 and 150ft, the plain slopes gradually and there is intermittent sand and exposed pavement. The pavement is colonized by primarily sponges and soft corals due to its periodic coverage by sand. Very few hard corals were encountered. The slope become steeper at approximately 150' and it varies in angle with small intermittent rock ledges exposed between steep sand drops. The ledges are colonized by sponges, predominantly *Xestospongia muta*, soft corals, branching sponges, hydroids and a very few hard corals. Black corals become present at 100' and are one of the most abundant species at depth.

This continues between 150’ and 600’ at which time the slope becomes less severe. Below 350’ only a few hydroids and black corals were noted.

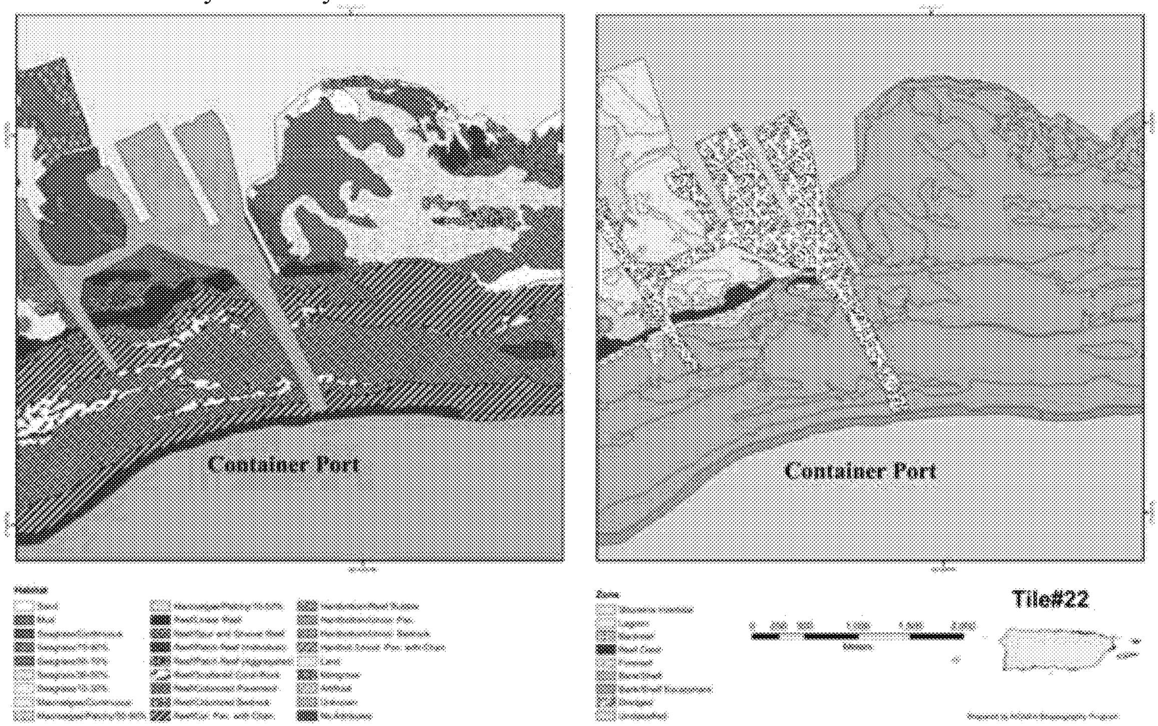

Figure 2. The NOAA NOS Benthic Habitat Map Tile 22 shows the area off shore of the terminal as a mixture of seagrass and reef with the channel show as blue and unknown.

Off the eastern jetty, the NOS habitat map shows a linear reef to the east of the jetty and an expansive pavement and pavement with channels to the south. These features area adequately depicted and were what was found during detailed benthic surveys. To the west of Limetree Channel and to the south of the Cross Channel, the map depicts continuous seagrass beds. While seagrass beds are present, they are not as continuous as shown in the map. The map then shows linear reef along running between the two channels. This shallow reef crest is composed primarily of *Acropora* skeletons and has minimal colonization by live corals. The map then shows reef colonized pavement and reef colonized pavement with sand channels extending off shore to the drop, however on the western side of the channel past a depth of approximately 30’, expansive sand flats varying from colonization by algae and seagrass to expansive areas of uncolonized sand and sponge and soft coral colonized emergent pavement are present.

VI. COMPENSATION FOR UNAVOIDABLE IMPACTS

Reason for Mitigation

Detailed environmental surveys were conducted during the design of the project and were used to assist in the routing of the pipeline to minimize the benthic footprint and to avoid ESA species and critical habitat to the greatest degree possible. The pipeline is being installed off the end of the eastern jetty which reduces the overall in water length over 2000' compared to if the pipeline had been lain from the center jetty and almost 3000' had the pipeline been lain off the western jetty. The ESA species are present, both *Acropora palmata* and *Orbicella faveolata* are abundant on the dolos (large concrete tetrapods) and occur on the offshore pavement and channel edge. These species were mapped and were avoided in the pipeline footprint. The route has been designed to cross the channel as quickly as possible to get into areas of minimally colonized sand. The crossing is being made at the point with the easiest slope transition down in to and out of the channel without impacting ESA species. The PLEM is being placed at a water depth of 136' rather than at the original design location which would put it directly below the buoy at 650' of water depth to avoid zigzagging the pipeline down the slope that has scattered black corals, *Cirrhipathes leutkeni* colonization. The PLEM is being placed in an area with limited sponge colonization on pavement with a sand veneer. The anchors to hold the buoy and floating pipes in place will be located in areas of open sand and soft sediment devoid of colonization. The anchor locations are large enough so that the anchors chain will not impact black corals or sponges.

The final pipeline route will be marked prior to the start of construction. The engineers are estimating that the maximum potential construction impact footprint may be 65' wide coming off the jetty. This includes any potential impacts which may occur during the initial floating of the line, turbidity barrier placement, and turbidity created by the trenching. Therefore, all the corals throughout the first 70' along the route which are within 50' of the centerline of the route will the transplanted, the first 50-60' is minimally colonized therefore it is probably that only 20 corals will need to be transplanted. These corals will be transplanted to the recipient site to the west and south of Ruth Island.

There are corals including ESA corals on the dolos and on the pavement to the west of the trench excavation. The shallow area off the end of the jetty is almost continually pounded by on coming waves from the southeast and as such the placement of turbidity barriers around the end of the jetty to control turbidity is not feasible. The turbidity will be carried to the northwest from the excavation by waves and current. A double set of turbidity barriers will be placed to intercept the turbidity before reaching coral colonized dolos on the western side of the eastern jetty. The turbidity will be directed towards the channel and ship basins where suspended sediments can settle in the calmer water into areas of uncolonized seafloor. Because of the wave turbulence in this area, sediments are unlikely to settle on the nearby pavement except in the event of an extremely calm day. If an extremely calm day does occur, monitoring divers will remove any settling sediments.

The area offshore of the jetties is a rock pavement composed of old reef material and limestone. The breaking of this material will create an acoustic impact and therefore turtle and marine mammal monitoring will occur during all rock breaking activities. The area is too turbulent to effectively use bubble curtains, but the turbulence will help to dissipate acoustic impacts.

Over the next 988' of the route, the pipelines will be surface lain and will have an impact area of approximately 19.6' (pipe lines and concrete mattresses) in width, corals within 20' of either side of the route will be transplanted to the reef south of the channel. Approximately 920 corals will require relocation. The pipe line will then be trenched down the slope and across the channel. On the eastern side of the channel, 470' of pavement will be impacted in order to transition into the channel. Assuming the worst-case foot print of 31' of width, corals within 50' of the centerline will be transplanted to the reef structure to the west of the channel. The 50' width should encompass anchoring or spudding impacts as well as settling sediments. A total of 740 corals will be transplanted from this area. As the trenching occurs on the channel slope, the abundance of corals significant decreases to only 0.0036 corals/sqft and less than 40 corals will require transplanting.

The channel floor is soft unconsolidated material which is uncolonized in the area of the crossing. The material will be side cast during the pipe placement. A total of 40,000cy of material will be excavated. The material will be side cast rather than lifting the material completely out of the water and creating the turbidity throughout the entire water column. By keeping the material near the seafloor, it will keep the turbidity plumes near the uncolonized seafloor and very sparsely colonized lower area of the channel walls. Keeping the material in the water also avoids having the material dewater.

Beyond the western channel wall, the seafloor transitions into a pavement with a sand veneer. Like on the eastern side, the channel slope has minimal colonization and approximately 40 corals will be relocated from a swath 35' in length (amount of exposed hardbootm) and 100' wide.

A total of 1760 corals are estimated to be relocated. *Diploria strigosa, D. clivosa, Porites astreoides* and *Siderastrea siderea* are the most abundant corals in the area. The project footprint avoids all ESA corals; however, it is possible that several *Orbicella faveolata* may occur in the potential impact area. *Orbicella*'s abundance on both the pavement and on the channel, walls was 0.00019/sqft and due the sparseness of these corals on the channel walls it is extremely unlikely that one is within the footprint of impact on the channel walls and was missed during diver survey.

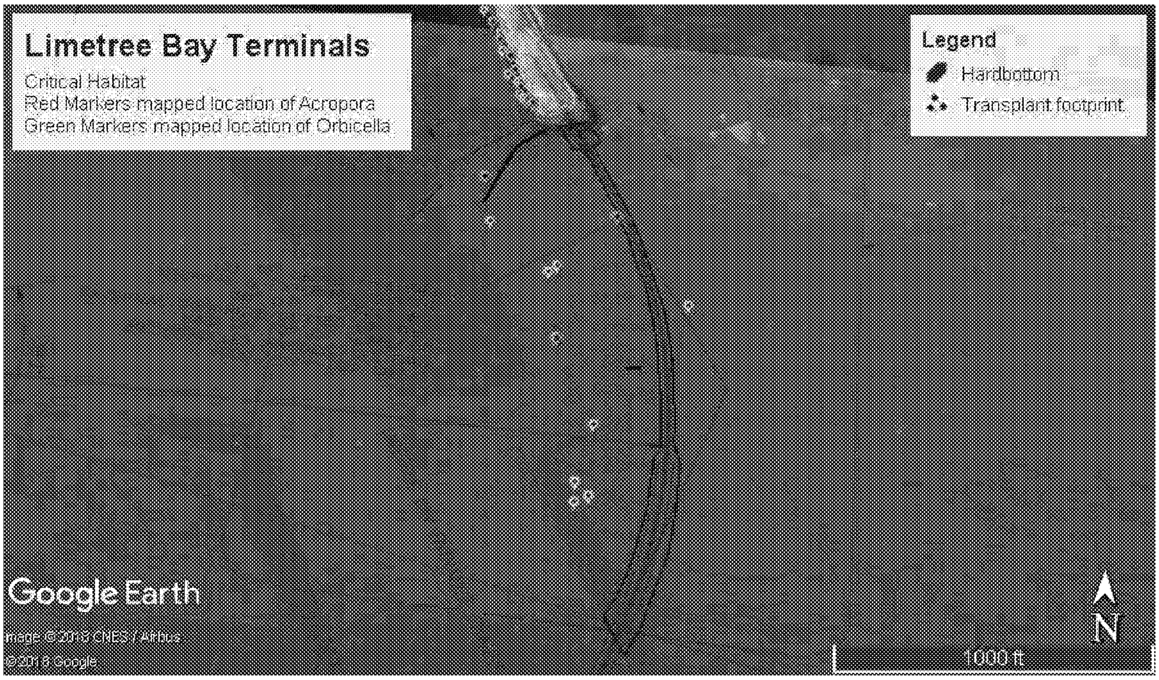

Figure 3. Transplant footprint

There were no *Orbicella* in the first 300ft of off the end of the jetty, however in the area where the pipelines will be trenched down into the channel these *Orbicella* may be present and based on a disturbance footprint of 62' wide (including anchoring/spudding and turbidity impact) and a transplant footprint of 100', 8 *Orbicella*s could occur in this foot print based on their density on the pavement. If an *Orbicella* or any other ESA coral is encountered the applicant will transplant them out of the impact footprint.

As per the requirement of the CZM permit, the project will be giving 10% of the corals which must be transplanted out of the impact footprint to TNC for their nurseries. Limetree is preparing a MOU so that TNC will be able to accept and monitor the survivability of these species. If any *Orbicella* do require relocation these will be taken to the TNC nursery site in Cane Bay during construction and post construction will be out planted at the Ruth Cay mitigation site. Upon set up of the TNC propagation raceway project which is expected to be up and running late this spring some of these corals may be used in some of their work with reef building corals. Some of the propagated corals will be out planted to the Ruth Cay mitigation site post construction.

The pipelines along the western shelf will impact areas of dense algae colonization and areas with scattered sponges and soft corals. The placement of the PLEM may impact a few scattered sponge species. Two anchors area needed to assist in stabilizing the hoses and the proposed potential footprints of the anchors are in areas of uncolonized sand along the slope. The anchors that balance the Buoy are also in areas of uncolonized sand and with the lack of colonization around these areas. The impact of anchoring either with piles will be minimal. The buoy pile anchors will be 72" diameter by 80' long.

Very specialize equipment will be used to drill and grout the deep anchors, and contractors skilled in work at these depths will be utilized. Placements will be surveyed by ROV and a report regarding the placement will be provided to the agencies as a part of the monitoring activities.

The installation of the SPM will result in maximum impact to 40,320 sf of rock pavement and hardbottom on the channel slopes of that amount 34,785 sf could be considered Critical Habitat. The project will also impact 52,700sf of soft channel bottom and 34,513sf of sand with scattered emergent pavement with sparse colonization by sponge species. Pile anchors and their associated chains will impact uncolonized sand and soft sediments.

VII. MITIGATION WORK PLAN

Divers will first collect those corals and sessile invertebrates that colonize cobbles and rocks within the transplant footprint. Divers will wear disposable gloves while working with corals and keep any coral that appear unhealthy or diseased away from other corals. If a coral is handled that appears unhealthy or diseased, gloves will be changed prior to working with other corals. The corals will be placed in underwater bins and these bins will be used to relocate the corals. Once the basket is full it will be carried by the diver and placed on the transport tray or into a transport bucket. The transport tray will be attached to the underside of the vessel so that corals may be transported to the recipient site. Once the tray is full it will be lifted beneath the boat and at idle speed carried to the relocation site. The relocation site is on the west and souths side of Ruth Island. Once on site the tray will be lowered near the seafloor and divers will remove the corals from the tray. These rocks or cobbles will then be fixed in placed in their new locations with either two-part underwater epoxy, which sets in a matter of minutes (Slashzone) or hydraulic cement. The base of the rock will be carefully cleaned with a wire brush and the new substrate will be cleaned to remove algae and any other material which might interfere with the adhesion of the epoxy or cement. The rock or cobble will be carefully placed in its new place on the pavement and held until the epoxy or cement starts to set.

Individual corals that are attached to the pavement then will be removed with chisels. This includes small head and plate corals. When the basket is full, it will be carried by the diver over to the transport tray or into a transport bucket. The transport tray will be attached to the underside of the vessel so that corals may be transported to the recipient site. Once the tray is full it will be lifted beneath the boat and at idle speed carried to the relocation site. The relocation site is on the west and south sides of Ruth Island. Once on site the tray will be lowered near the seafloor and divers will remove the corals from the tray. These corals will then be fixed in placed in their new locations with either two-part underwater epoxy, which sets in a matter of minutes (Slashzone) or hydraulic cement. The base of the coral will be carefully cleaned with a wire brush and the new substrate will be cleaned to remove algae and any other material which might interfere with the adhesion of the epoxy or cement. The coral will be carefully placed in its new place on the pavement and held until the epoxy or cement starts to set.

If sea conditions are rough enough that there is difficulty using the underwater tray the corals will be moved in the transport buckets which will be hoisted on to the boat keeping the corals in water all the way to the transplant where they will be lowered to the seafloor for replanting.

Because the coral in Limetree Bay are thriving Virgin Islands DPNR CZM has requested that ten percent (10%) of the transplanted corals be relocated to The Nature Conservancy (TNC) coral nursery to strengthening the population. TNC's coral nursery site is on the north shore of St. Croix in Cane Bay. These corals will be placed in bins and transported by vessel to Cane Bay where they will be lowered to the seafloor and attached in locations designated by TNC.

In the event an anchoring or spudding footprint cannot be established that is uncolonized, the corals or sponges in that footprint will be relocated to the recipient site.

In the event that seagrass spreads into the project footprint during the permitting process or if a barge must anchor or spud in the seagrass, the seagrass will be transplanted prior to that action. The sediment in the area is a course sand and the seagrass will be uprooted taking care not to break the roots. The seagrass will be placed in a basket and carried underwater to the recipient site where a depression will be dug, and the roots and rhizomes buried. The seagrass will be relocated 50ft to the east of where the impact occurs.

VII.1 Hardbottom Impacts

The installation of the SPM will result in impact to the follow areas of what can be considered hard bottom and critical habitat:

Hardbottom analysis/Critical Habitat	Orgininal critical habitat disturbance (sq. ft.)	Critical Habitat Revised for 31 feet width no sidecasting and arching pipeline (sq.ft.)
Off end of Jetty Trenching = 62ft x 226ft (288ft-62ft upland/dolos) - 14,102 sf	14,012	
Off end of Jetty Trenching = 15ft x 35ft - 525sf		525
Surface Lain Pipe = 11ft x 888ft - 9,768sf	9,768	
Surface Lain Pipe = 11ft x 988ft - 10,868sf		10,868
Mattresses (max number 111 @84.8sf/ea)	9,413	
Mattresses (max number 115 @84.8sf/ea)		9,752
Channel Trenching East = 62ft x 420ft - 26,040sf	26,040	
Channel Trenching East = 31ft x 470ft - 14,570sf		14,570
Channel Trenching West = 62ft x 35ft - 2,170sf	2,170	1,085
Hardbottom West of Channel 320ft x 11ft	3,520	3,520
Total distrubance sq feet	64,923	40,320
Total in acres	1.4904	0.9256

Compensation for Hardbottom and Critical Habitat Impact

To compensate for impact to hardbottom and critical habitat Limetree proposes collection of 500 ESA listed coral fragments from other areas in St. Croix and the U.S. Virgin Islands (corals of opportunity). Half of the collected corals (250) would be transplanted into the enhancement site adjacent to Ruth Island; half of the collected ESA listed coral fragments (250) would be donated to the TNC to re-establish their coral nurseries. The 250 corals provided to TNC may be timed with their completion of the raceways which are expected to be operational in April of 2019. TNC is also looking at establishing an addition nursery off of Kramer's Park in the EEMP and collected corals may be used in that location, again this will be timed when TNC is ready to accept the corals. Over the last 6 months corals of opportunity have been seen within Christiansted Harbor near Round Reef, along the barrier reef and near the linear reef off of Teague Bay on the north shore of St. Croix. Fragments and loose corals would be collected by divers placed in water filled bins and carried to the enhancement site at Ruth Island. The corals and coral fragments will then be attached using the same methods used to relocate the transplanted corals. Because these corals have been loose for some time it is probable that the removal of algae with small metal brushes will be required. *Acropora, Orbicella spp.* and *Dendrogyra cylindrus* will all be collected when found. Half of the collected corals will be given to TNC to be used as part of their nursery program. If collected corals lend them to fragmentation, the corals will be fragmented to increase the number of corals out planted at the enhancement site.

Limetree will also work with TNC to develop an outgrow program so that in the future coral fragments grown in their nurseries can be transplanted into the enhancement site as well as an additional site off of Great Pond south shore St. Croix. Great Pond is within the EEMP and CZM will allow corals of opportunity to be collected from the EEMP and replanted at the Great Pond Site. Limetree will work with the EEMP so that they may conduct their own monitoring in the future for the out planted corals. TNC anticipates that they will have their raceways ready to accept the corals for fragmentation in April of 2019 and then will require 6 months to grow the fragments to sufficient size for out planting. Divers will collect sufficient *Acropora palmata* of opportunity for TNC, so that they can outgrow 1405 *Acropora palmata* and 1545 *Acropora cervicornis* for Limetree to outplant. Of the 1405 *A. palmata*, 100 would be planted at Ruth Island and the remaining 1305 would be planted on the barrier reef south of Great Pond. Of the 1545 *A. cervicornis* 100 would be planted at 1545 and 1445 would be planted on the barrier reef south of Great Pond. Based on the estimates provided by TNC corals would be ready for out planting in the last quarter of 2019.

VIII. MAINTENANCE PLAN

Divers will survey the coral recipient sites, both the transplant and out planting site on a bi-weekly basis for the first four months after the transplant to ensure that the corals have not become unattached or shifted this includes the coral of opportunity planting and outgrow planting. If for any reason the corals become loose or move, they will be re-situated and or reattached. After the first four months, the corals will be monitored on a monthly basis, making sure that the rocks have remained stable and not shifted, and that corals and sponges have not come loose. If necessary, corals will be repositioned and re-attached. If seagrasses are transplanted, they will be re-rooted as necessary.

IX. ECOLOGICAL PERFORMANCE STANDARDS

In order to objectively evaluate the mitigation project, ecological performance standards must be established. The object of this mitigation is to minimize impact to benthic resources which provide high quality habitat to protect marine species. The performance standards will include viability of the transplanted corals as well as their use by protected species.

It is the intent of this transplanting and out planting program to obtain a minimum of 85 percent survival of the transplanted corals, out planted corals and seagrasses and no net loss of tissue (pooled) for any one coral species. Limetree Bay Terminals, LLC is committed to put forth the greatest effort to see that the relocation is successful and that they obtain the greatest potential survival of transplanted organisms. Coral Transplants in the VI have been very successful with survival rates in the 95 percent range ((Frederiksted Pier Extension, Enighed Pond, Mangrove Lagoon WWTP Outfall). The only time survival has fallen below that mark is when black band disease has spread across the reef area damaging both the recipient site corals and the transplanted corals (this occurred 2 years into the Crown Bay Marine Terminal Coral Transplant).

X. MONITORING REQUIREMENTS

Monitoring the compensatory mitigation project site is necessary to determine if the project is meeting its performance standards and to determine if measures are necessary to ensure that the compensatory mitigation project is accomplishing its objectives.

As per the guidelines set forth in §230.96, monitoring the mitigation project will be for a minimum period of 5 years for all corals.

In total, twenty-five percent of the transplanted corals representative of all the species and all sizes classes of corals relocated will be marked with numbered tags for monitoring (440). At least 10 colonies of each species, and all of the species if there are less than 10, will be monitored. Twenty-five percent of corals encompassing the same species and size class already at the transplant site will also be monitored as controls. These corals will be marked and surveyed at the conclusion of the transplant. The marked corals will be surveyed for health and photographed on a monthly basis for the first twelve (12) months. Maintenance will also continue throughout this time to ensure that corals reattach to the new substrate. All photographs will include location and scale as well as the description of the health of the corals photographed. Corals will then be monitored every two months for the next two (2) years and then every six (6) months for the following two (2) years.

Approximately twenty-five percent (65) of the 250 ESA corals in the recipientwill also be tagged for photographs on a monthly basis for the reports, but 100 percent of the ESA corals will be monitored every month and any change or demised will be reported. For the outgrown corals 100% of the corals will be monitored for survival and pictures will be used to document their growth.

If at any time during the monitoring degradation of the corals is noted, these corals will be compared to those within the other monitoring quadrats and corals in areas outside the impact area of the transplant project. This information will be used to determine whether the degradation of the corals is due to the transplant activities. If the corals appear to be stressed due to the transplant, the reason for the demise will be assessed, poor positioning, sand scour, light attenuation, etc. If necessary, the coral will be repositioned. Every effort will be made to save the coral. If the degradation is seen both in the project area non-transplanted corals and the transplanted corals, the reason of the demise will be assessed.

If seagrasses are transplanted, 25 quadrats will be established in the new seagrass bed and seagrass will be monitored for survival and growth. The marked seagrass will be surveyed for health and photographed on a monthly basis for the first twelve (12) months. Maintenance will also continue throughout this time to ensure that the seagrass re-roots in its new location. All photographs will include location and scale as well as the description of the health of the seagrass photographed. The seagrass will then be monitored every two (2) months for the next two (2) years and then every six (6) months for the following two (2) years.

The results of the monitoring will be delivered to the agencies including NMFS PRD, NMFS EFH, COE, CZM and ACE as soon as possible after monitoring period. If negative impacts are noted, the agencies will be notified by phone and by email within 24 hours. The agencies and NMFS will be apprised of what steps are being taken to identify the impact and rectify the problem. The agencies including NMFS will be provided a detailed report on the steps that are taken and the results of those actions.

XI. LONG TERM MANAGEMENT PLAN

Limetree Bay Terminals is committed to seeing the success of the mitigation plan and protecting the recipient site long term. Limetree Bay Terminals understands that the proposed five (5) years monitoring plan will be sufficient to ensure the long term success of the mitigation. The only long-term monitoring activity proposed in this plan at this time is the maintenance for 10 years of the proposed aids to navigation buoys, which would alert boaters of the presence of the coral mitigation areas. However, as stated in other sections of this document, if after reviewing the results of the monitoring activities and reports, it is determined that additional long-term maintenance activities are necessary, Limetree Bay Terminals will coordinate with NMFS and USACE to modify this mitigation plan, DA permit and/or the Financial Assurance accordingly as appropriate.

XII. ADAPTIVE MANAGEMENT PLAN

In the event that there are difficulties with mitigation as planned or additional unanticipated impacts occur, Limetree Bay Terminals is prepared to take additional steps to see that compensatory mitigation is achieved for both ESA species and EFH. If necessary, extended monitoring and maintenance or additional marking of the site will be undertaken in order to meet the mitigation goal.

If the mitigation goal of 85 percent survival at the end of five (5) years is not met, the applicant will prepare a detailed report of why the mitigation was not successful and will meet with the permitting agencies and coming up with additional compensatory mitigation to meet the mitigation goal.

XIII. FINANCIAL ASSURANCES

Limetree Bay Terminals is committed to conduct this compensative mitigation plan and will guarantee that the mitigation plan, maintenance, and monitoring will occur as proposed. Limetree Bay Terminals, LLC will secure a bond in the amount of $1,590,500.00 following the guidelines set out by the U.S. Army Corps of Engineers Regulatory Guidance Letter No. 50-1, 14 February 2005, SUBJECT: Guidance on the Use of Financial Assurances, and Suggested Language for Special Conditions for Department of the Army Permits Requiring Performance Bonds. The bond amount was determined based on the following table.

Coral Transplant Mitigation

Coral Transplant	Cost	NMFS Biop	Units
Mark Route and transplant zones	$12,000.00	$ 12,000.00	1
This includes boat, divers, equipment.	$330,000.00	$ 330,000.00	45
Reattachment, relocation if necessary			
This includes boat, divers, equipment.	$15,000.00	$ 60,000.00	4
This includes boat, divers, equipment and reporting.	$15000/ea	$150,000.00	10
This includes boat, divers, equipment and reporting.	$15000/ea	$90,000.00	6
This includes boat, divers, equipment and reporting.	$15000/ea	$ 90,000.00	6
Final Report	$6,000	$6,000.00	1
		$738,000.00	

Seagrass Transplant Mitigation and Additional Costs

Seagrass Transplant		Cost	Extended
Transplant a total 6,806 sq. ft. or 0.16 acre of Thalassia and 8,454 sq. ft. or 0.19 acre of Syringodium. These seagrasses will be relocated to the east of the channel into seagrass blowouts and scars.	This includes boat, divers, equipment.	$16,000.00	$16,000.00
Monitoring of Transplanted Seagrass			
Year 1 Monthly Monitoring 10 events	This includes boat, divers, equipment and reporting.	$4,000.00	$40,000.00
Year 2-5 Quarterly Monitoring 16 events	This includes boat, divers, equipment and reporting.	$4000.00/ea	$54,000.00
Total			$130,000.00
Other Cost			
Contingency		$25,000.00	$25,000.00
Buoys	buoys and tackle (2)	$1750.00/ea	$3,500.00
	installation	$2500.00/ea	$5,000.00
Buoy Maitenance	10 years	$5,000.00	$5,000.00
Cost for Bond			**$168,500.00**

Compensatory Mitigation

Enhancement		Cost	Extended	Units
Collection	To compensate for impact to hardbottom and critical habitat Limetree proposes collection of 500 ESA listed coral fragments from other areas in St. Croix and the U.S. Virgin Islands (corals of opportunity). Half of the collected corals (250) would be transplanted into the enhancement site adjacent to Ruth Island; half of the collected ESA listed coral fragments (250) would be donated to the TNC to re-establish their coral nurseries.	$80,000.00	$ 80,000.00	20
Outplanting	Out plant 250 corals into our mitigation area and outplant or place 250 corals in TNC nursery.	$20,000.00	$20,000.00	5
ESA Out Planting	Divers will collect sufficient Acropora palmata of opportunity for TNC, so that they can outgrow 1405 Acropora palmata and 1545 Acropora cervicornis for Limetree to outplant.	$120,000.00	$120,000.00	30
1405 A. palmata	Of the 1405 A. palmata, 100 would be planted at Ruth Island and the remaining 1305 would be planted on the barrier reef south of Great Pond.	$56,000.00	$56,000.00	14
1545 A. cervicornis	Of the 1545 A. cervicornis 100 would be planted at 1545 and 1445 would be planted on the barrier reef south of Great Pond.	$60,000.00	$60,000.00	15
Monitoring of Enhancement Corals				
Maintenance	Divers will survey the coral recipient sites, both the transplant and out planting site on a bi-weekly basis for the first four months after the transplant to ensure that the corals have not become unattached or shifted this includes the coral of opportunity planting and outgrow planting.	$1500.00/event (overlaps partially with outher monitoring.	$12,000.00	8
Monitoring	Monitoring 62 additional corals (24 total events)	$2500.00/event (overlaps partially with outher monitoring.	$60,000.00	24
Monitoring of Outplanted Corals				
Maintenance	Divers will survey the coral recipient sites, both the transplant and out planting site on a bi-weekly basis for the first four months after the transplant to ensure that the corals have not become unattached or shifted this includes the coral of opportunity planting and outgrow planting.	$9000.00/event	$ 72,000.00	8
Year 1 Monthly Monitoring 10 events	This includes boat, divers, equipment and reporting.	$9000/ea	$ 90,000.00	10
Year 2 Bi-Monthly	This includes boat, divers, equipment and reporting.	$9000/ea	$54,000.00	6
Year 3-5 Semi-annual Monioring 6 events	This includes boat, divers, equipment and reporting.	$9000/ea	$ 54,000.00	6
Final Report	Final Report	$6,000	$6,000.00	1
Total			**$ 684,000.00**	